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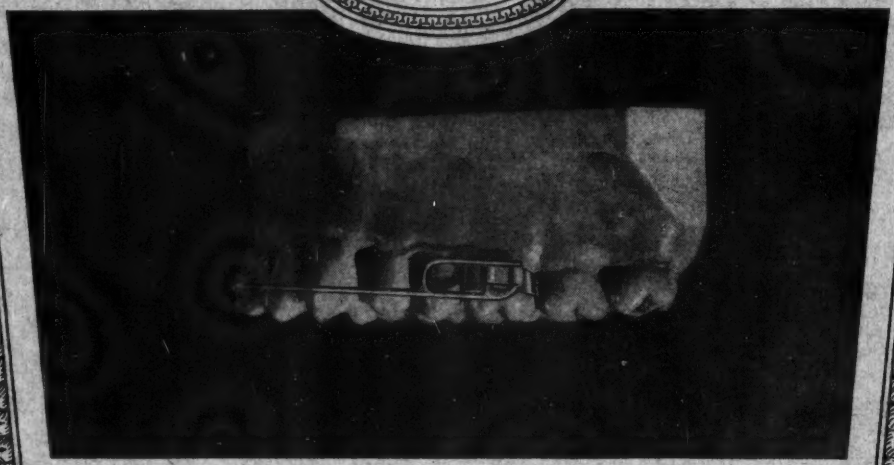

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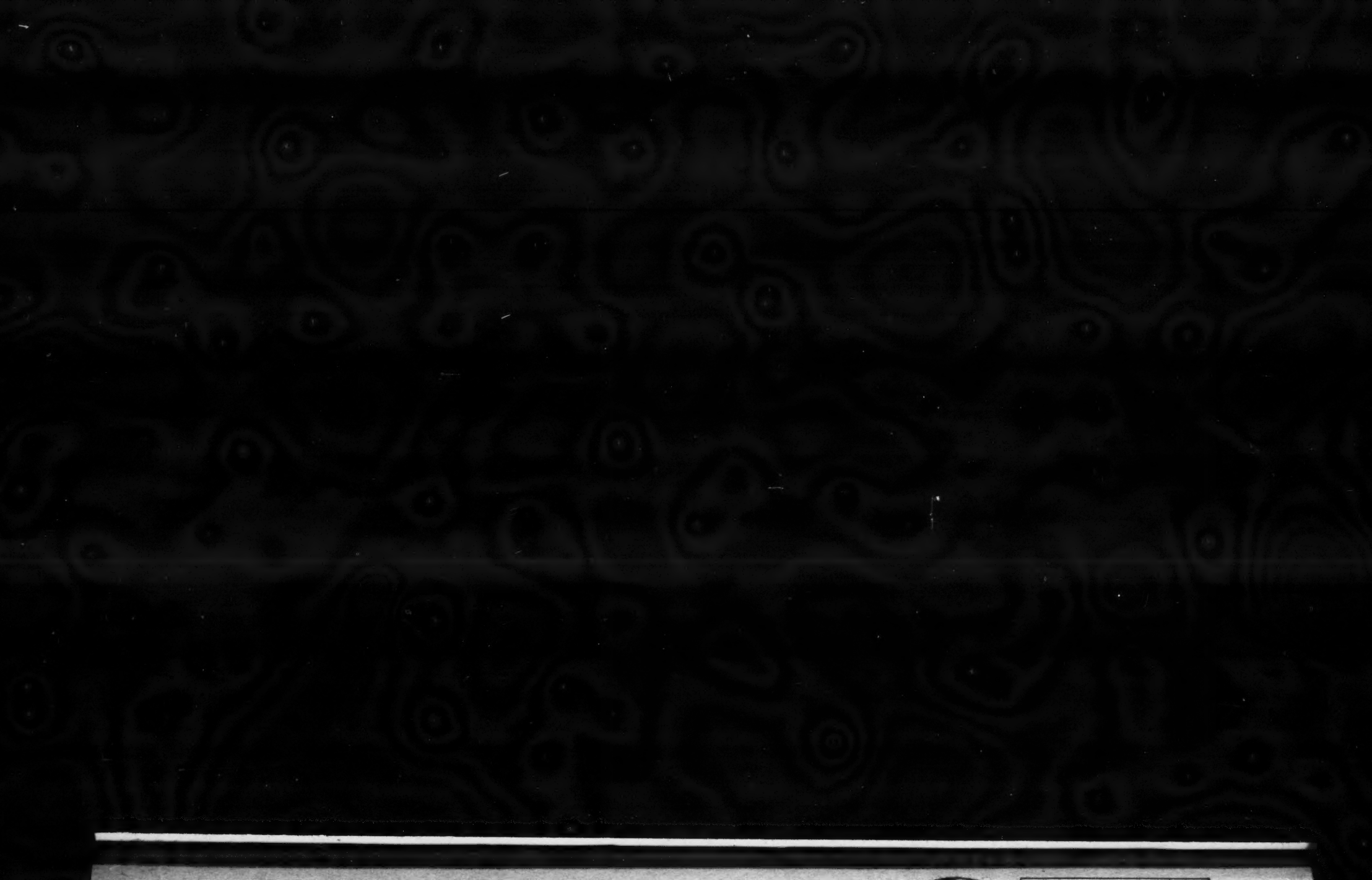

The International Journal of
Orthodontia, Oral Surgery and Radiography

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VOL. XIV ST. LOUIS, MARCH, 1928 No. 3

ORIGINAL ARTICLES

THE VALUE OF ORTHODONTIC APPLIANCES TO IMMOBILIZE JAW FRACTURES*

BY M. N. FEDERSPIEL, M.D., MILWAUKEE, WIS.

FRACTURES of the maxillary bones frequently involve complications of a complex nature. This is largely the result of the peculiar anatomic relation of the teeth and their usual pathologic manifestations. Clinical findings pertaining to the teeth and their investing structures prove that disease is rarely absent here. Tooth decay, gangrenous pulps, chronic pericementitis, and periapical infections are so frequently a constant pathologic phenomena that their absence is a rarity in the civilized human being.

Naturally, a fracture of the jaw bone in the region of the teeth may give rise to serious complications, often producing alarming symptoms. The result may be loss of anatomic structures with marked deformity and impaired function and sometimes a fatality.

In order that these serious and complex pathologic changes may be minimized in treating jaw fractures, it is necessary to fully comprehend the anatomic structures of the teeth and jaws and adjacent structures. Also to have a clear understanding of histopathology and a knowledge of surgical and orthodontic principles.

Strange as it may seem, fatal results following jaw fractures, even when of a complex nature, are few. Statistics prove that the mortality barely reaches one per thousand if we exclude cases of severe hemorrhage and cases where the general condition is poor from complications such as pyemia of buccal origin and septic pneumonia.

Before attempting the treatment of jaw fractures it is advisable to consider the anatomic relation and physiologic peculiarities of the teeth and jaws. Occlusion of the teeth is important. When the teeth occlude normally, all the inclined planes of the cusps are in correct relation. A deviation from the normal is considered a malocclusion.

*Read before the Twenty-sixth Annual Meeting of the American Society of Orthodontists, Chicago, May 2-5, 1927.

Surgeons who are not familiar with the anatomic relation of the teeth should realize that jaw fractures differ considerably from those fractures which the general surgeon is usually required to treat. Although many people have malocclusions, still mastication may be performed with a great degree of efficiency. If a fracture occurs in such a case, dental adjustment of the broken bones should be such as to restore the original relation of the teeth, in order to insure mastication after healing has taken place.

While efficient mastication is dependent on dental adjustment, rigidity of the broken bone is also a factor and both should be considered of paramount importance. If, however, a fracture of the jaw is accompanied by loss of bone substance, especially in the mandible, one is confronted with the serious consideration of choosing either one or the other. In such a case to obtain a correct relation of the teeth by dental adjustment, the fragments of bone must remain apart, resulting in a pseudoarthrosis. To obtain rigidity, the fragments must be held together, resulting in a deformity. Personally, I prefer the deformity to pseudoarthrosis. In most cases the deformity is slight and further adjustment of the teeth can be obtained by orthodontic care or prosthetic restoration.

Patients suffering under the disability of pseudoarthrosis are at a greater disadvantage than those with a rigid mandible short of sufficient bone substance and accompanied by extreme malocclusion. Yet with this deformity, the various movements of the mandible with its duplicate articulation, permit mastication of considerable efficiency.

In times of peace, dentofacial mutilations are rare—consequently the surgeon seldom treats cases where there is loss of bone substance. The usual cases in civilian practice, though of a severe nature at times, rarely manifest loss of bone substance sufficient to cause mutilation.

When treating fractures of the jaws it is necessary, first, to place the broken parts in correct anatomic position. Second, to immobilize the bones to obtain rigidity. Third, to prepare for complications and treat accordingly when they occur.

When attempting to replace the broken bones in correct anatomic position, it is important to study carefully the relation of the teeth. The restoration of the teeth to their former position in occlusion will determine the correct relation of the jaws.

Radiograms are of great aid, not only in making it possible to visualize the line of fracture, but also in showing any existing pathologic conditions within the jaw structures. Infected teeth, broken down, degenerated roots, cysts, and impacted teeth will frequently be found within the line of the fracture. If this is the case, surgical interference is at once necessary in order to remove any pathologic condition that might give rise to complications. Gingival pockets should be carefully swabbed with a 10 per cent solution of chromic acid.

Since the introduction of orthodontic principles and practice, oral surgeons are adopting its usage to make and fit bands and appliances for the purpose of immobilizing fractures of jaws that possess a sufficient number of teeth to permit the execution of these principles.

When the technic of making and fitting orthodontic appliances to the teeth is mastered, immobilization of the jaws is comparatively an easy matter and is far more practical than any other method that has been heretofore used.

Especially is this true in fractures of the mandible. The number and variety of the movements which this bone possesses is of a peculiar physiologic interest and yet its capacity for immobilization is greater than any other bone in the body.

By attaching bands with hooks and alignment wires to the teeth and firmly ligaturing the two arches together with copper wires, the mandible becomes immobilized and renders possible the rapid consolidation of the fracture. While this debars mastication, feeding is not prevented. Liquids can be sucked through the dental interspaces. If, however, the teeth are so close together that fluids cannot pass through, then it is advisable to extract one

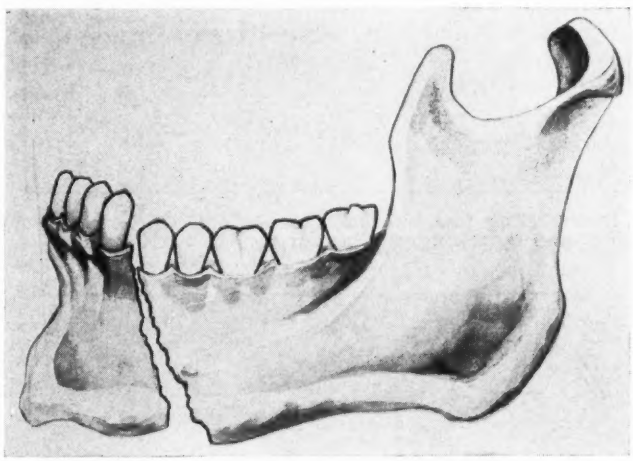

Fig. 1.—A compound fracture between $\overline{|3}$ and $\overline{|4}$.

molar (before immobilization of the jaws) to permit drawing liquids through the open space left after the removal of the tooth. Frequently there are open spaces as a result of teeth previously lost or the retromolar spaces may permit a sufficient opening to draw fluids into the mouth to nourish the patient while the jaws are fixed.

Several months ago a young man, twenty-one years of age, fractured his mandible while playing football. He was in good health and possessed an excellent set of teeth, free from caries and gingivitis. The occlusion was in correct anatomic relation and the facial lines were harmonious. He was sent to a local hospital where an attempt was made to immobilize the fracture with a crossed bandage. While this method seemed to rest his jaw, there was a noticeable shifting of the mandible with the result that the dental arches were in marked malrelation. Fearing that this condition might become permanent, his physician advised intraoral immobilization.

The third day following the accident I was asked to assist in the treatment of the case.

Fig. 1 illustrates the compound fracture of the mandible between $\frac{|}{|34}$

In order to obtain room between the teeth to permit bands to be fitted, the teeth were carefully wedged apart for twenty-fours with rubber pads. Then the mandible was anesthetized by blocking off the third division of the fifth nerve. This permitted manipulating the jaw and operating on the teeth

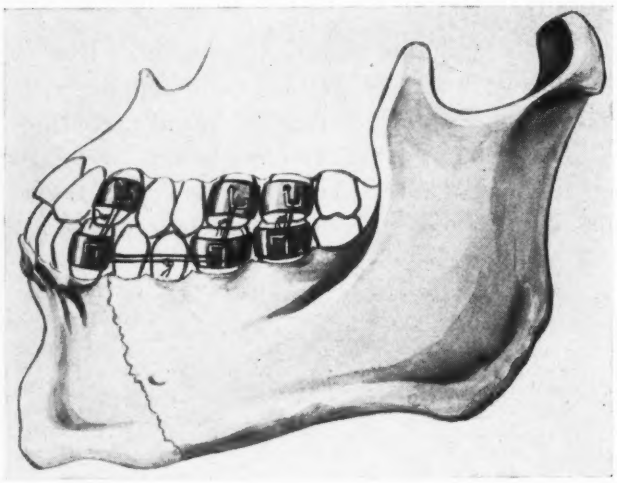

Fig. 2.—Illustrates immobilizing jaw fracture. Bands with hooks are cemented to the teeth and by wiring, the broken bone is stabilized.

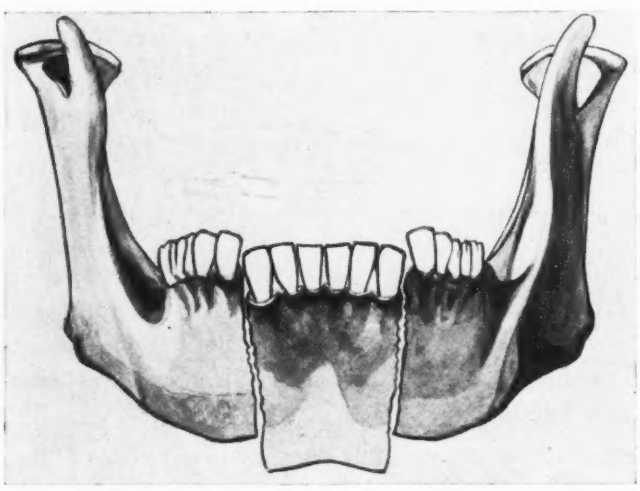

Fig. 3.—A bilateral compound fracture of the mandible.

without any discomfort to the patient. Seamless bands (German silver) with hooks were fitted to $\frac{3|67}{3|67}$ and wired as illustrated in Fig. 2. The jaws were securely immobilized. Feeding was maintained by sucking liquids through the open retromaxillary spaces.

The teeth could be brushed on the labial and buccal sides and the mouth washed with a 50 per cent solution of peroxide of hydrogen. The solution was sucked in and forced out through the interproximal spaces. The patient

made a rapid recovery and four weeks later the appliances were removed and the teeth were thoroughly cleaned. The relation of the teeth was perfect.

Fig. 3 illustrates a bilateral, compound fracture of the mandible. The central portion supporting $\frac{|}{321\,|\,123}$ was pulled down by the action of the anterior belly of the digastricus and the geniohyoideus muscles. The patient, a young lady, had been injured in an automobile accident. Here again was a case of beautiful teeth necessitating accurate and careful attention to fix the fracture so that there would be a normal alignment of the teeth in correct anatomic occlusion.

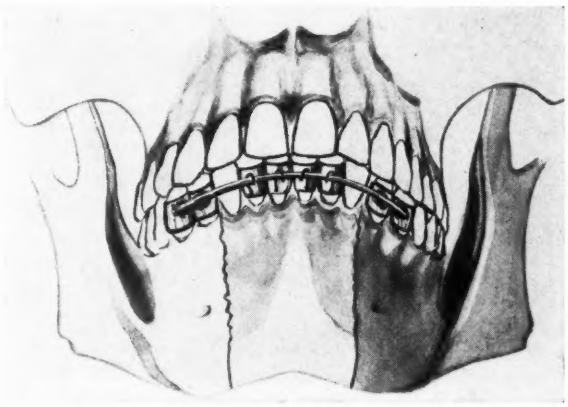

Fig. 4.—Illustrates the value of an orthodontic appliance to immobilize the broken mandible.

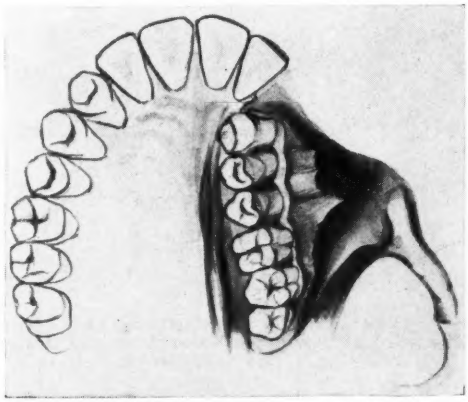

Fig. 5.—A fracture of the left maxilla exposing the antrum. The $\underline{|\,345678}$ with the alveolar process was shifted inward.

Bands were fitted on the following teeth $\frac{|}{54\ 21\,|\,12\ 45}$, and hooks were soldered to the bands on $\frac{|}{21\,|\,12}$. An alignment wire (15 gauge German silver) was shaped to rest against the labial surface of the lower anterior teeth and soldered at each end to the bands on the premolars, and cemented in place. The displaced central portion of the mandible was then gently forced into normal position. The bands, with hooks on the incisors, were cemented into place so that each hook rested on the alignment wire. This simple appliance firmly immobilized the fractured bone. (See Fig. 4.) The patient could

move the mandible during light feeding and talking without any discomfort. This form of appliance eliminates the necessity of bandaging. Cleansing the teeth by brushing and washing the mouth with a suitable antiseptic could be done while consolidation of the broken bones took place.

These two cases illustrate the advantages of immobilizing fractures of the mandible where there is a sufficient number of teeth to permit the fitting and cementing of bands and orthodontic appliances.

Fractures of the maxilla likewise can be immobilized with orthodontic appliances in order to safeguard against a malocclusion after healing has taken place. Fig. 5 illustrates a fracture of the maxilla of a young woman.

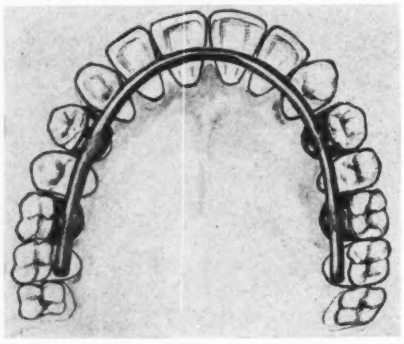

Fig. 6.—Showing a 15 gauge German silver wire soldered to bands cemented to $\frac{64 \mid 46}{\mid}$. This appliance stabilized the fracture as illustrated in Fig. 5.

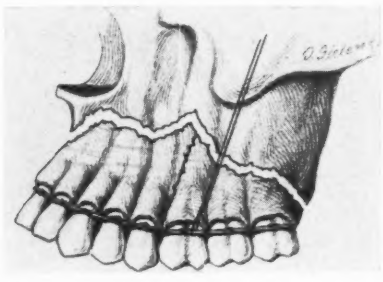

Fig. 7.—Showing the maxilla loose from its attachment. Notice alignment arch gauge 15 wire to all the teeth. The wire attached to the arch at the first molar was passed through the cheek. See Fig. 8.

The canine, premolars and molars on the right side, with their alveolar process, were torn loose and shifted lingually. The antrum was opened in the region of the alveolar culdesac. The antrum was thoroughly irrigated in order to wash out the blood clots and the broken bone was forced into normal position. Bands were fitted to $\frac{64 \mid 46}{\mid}$. To these bands an alignment wire (gauge 15) was shaped to rest against the lingual surfaces of the maxillary teeth and soldered to the bands (Fig. 6). The appliance was then cemented into place. This simple and efficient appliance immobilized the fracture permitting consolidation to take place.

A fracture that will cause a complete displacement of the maxilla from its attachments sometimes occurs, as is illustrated in the following case.

Mr. F. W., twenty-eight years of age, while driving his car at a terrific rate of speed, lost control of the auto and struck a large tree. The force of the impact caused his face to strike against the steering wheel, tearing the entire maxilla loose from its attachments. (Fig. 7.) Since the accident happened 25 miles from the nearest physician, there was considerable delay in giving the patient first aid. After several hours he was taken to a local hospital where he was given the usual care to overcome the symptoms of shock which were now manifest. As there were no provisions at the hospital to enable the surgeons to immobilize the multiple, compound fracture of the maxilla, nothing was done except to repair the lacerated lip and to keep the mouth irrigated and cleansed. One week following the accident the patient had sufficiently recovered from the shock to be transferred to St. Mary's Hospital, Milwaukee. He was admitted on October 21, 1926, and this same day I saw the patient for the first time.

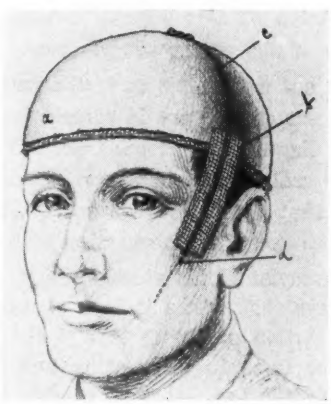

Fig. 8.—*a*, showing plaster of Paris cap; *b*, gauge pad; *c*, copper wire; *d*, opening into cheek.

Examination.—The patient had a marked ecchymosis involving the entire face, and the lips were badly swollen and bruised. The maxilla was displaced downward and backward, exposing both antrums in the region of the alveolar culdesac. The vomer was detached from the palate at their junction. There was a vertical fracture between $\frac{|\,56}{|}$, connecting with the horizontal fracture above. The crowns of $\frac{21\,|\,1}{|}$ were broken near the incisal edge. There was also a vertical fracture between $\frac{1\,|\,1}{|}$ which joined with the open space caused by the separation of the maxilla from the vomer.

The x-ray findings were as follows: Comminuted, compound fracture of both superior maxillary bones. Nasal, orbital and outer walls of antrum all show fractures.

On October 23, 1926, under ether anesthesia, an alignment wire (gauge 15) was fitted to the upper arch to cover the outer surfaces of the teeth. All of the upper teeth were then ligated to this base wire which firmly immobilized the broken maxilla and kept the teeth in good alignment. The maxilla

was then manipulated until it was forced back into its original position and held there by wires attached to $\frac{5|5}{|}$. The ends of the wires were then drawn through the cheeks at the junction of the alveolar culdesac and fastened over the head, which had been previously covered with a plaster of Paris cap (Fig. 8). This method firmly immobilized the jaw in correct position.

Postoperative Care.—The oral cavity and the nasal passages were cleansed three times daily and the antrums were irrigated daily for a period of one week. No complications developed and the patient made an uneventful recovery. After five weeks he was dismissed from the hospital and advised to have dental care at a later date.

DISCUSSION

Guy Hume.—Mr. President, I wish to thank you for the honor you have done me in ordering me to open the discussion of this paper. I was not consulted in regard to this but was simply told that my name was on the programme.

Dr. Federspiel has thrown out a warning as to the possibilities of serious consequences arising if surgical treatment is not carried out in certain cases of fractures of the maxillae. To be able to make a thorough diagnosis and treat fractures of the maxillae, one must know, not only the conditions in the oral cavity, but have a knowledge of the anatomy of the adjacent structures. I believe that those who are not qualified to give this service should not undertake to treat these cases except in cooperation with a surgeon.

I do not agree with the essayist in his view of cases where there is loss of bone substance in the mandible. He says that where it is a choice of reducing the fracture from the standpoint of the correct relation of the teeth and the separation between the ends of the fracture or from having the teeth in malrelation and the ends of the fragments held together to obtain the rigidity of the bone, that he prefers the rigidity of the bone with its resulting deformity. Such wonderful results have been obtained by the operation of bone graft that I feel that we should not be satisfied with a compromise treatment. The bases of our treatment should be the original occlusion of the teeth and the conformation of the jaw so that there will not be any deformity. There would of course be exceptions on account of the patient's general debility or in cases where the general physical condition would not justify this operation.

In his reference to the feeding of patients in cases where the arches are wired together, I would not agree with the suggestion of removing a tooth for the purpose of feeding. Other means such as rectal feeding or feeding through the nose could be resorted to. In the majority of cases, liquids and semi-liquids are easily taken by the patient through the mouth.

The cases as illustrated by the slides have shown the principles of certain splints. I would differ with him in his treatment of his Case 1. Here is a patient with good history, full complement of teeth with a compound single fracture between the premolar and canine; instead of wiring the arches as has been done, I would prefer to use an intramaxillary splint, using the second premolar on the left side and a premolar or canine on the right side with a lingual bar soldered to them and cemented to place. This form of appliance would be much more comfortable for the patient, much better from a prophylactic standpoint. The matter of diet is solved as the patient would be able to use his mandible and be able to masticate soft foods. It is better to get your patients out in the sunlight if possible and have them carry on their usual occupations as soon as possible so that they will not worry over their condition. When the jaws are wired together they are under a handicap in this respect and are somewhat reticent in meeting other people.

Generally speaking, where the fracture is anterior to the last tooth or teeth, irrespective of whether it is compound single, unilateral or bilateral or multiple fracture, the principle of splinting the case should be an intramaxillary one if possible.

The use of the intermaxillary splint would be indicated in cases where the fracture is posterior to the last tooth. In some cases extensions have to be soldered to the splints to control the ramus. If intermaxillary force is to be applied, then it is advisable to use bilateral attachments.

No. 1, pg. 33: The reason I mention that here is that in the slide of Case 1 that was shown, the wiring was on one side only. I would also suggest that in the use of this splint as illustrated, if you are going to use intermaxillary splint as we had on the screen, where there were three teeth banded in the superior maxilla, it would be better to use, for instance, the canine and the first molar and join them by a buccal bar and cement that to place. Then you can make the attachments from the buccal bar in any place you wish. Another suggestion I would make in connection with that wiring, would be that I would keep away from the tooth that was approximating the fracture. I wish to thank you, Mr. President.

Dr. Jos. B. Eby.—The value of radiograms as an aid in making a diagnosis cannot be overestimated as pointed out by the essayist. A stereopticon view is sometimes necessary in order to detect obscure fractures. A short time ago, a surgeon referred a patient to me. His radiograms of the case showed a compound single fracture between the left lateral and canine in the mandible. From a digital examination neither of us could detect any other fracture. I was not satisfied that we could have so much displacement of the teeth with this fracture so that a stereopticon view was obtained which revealed an oblique fracture in the ramus. The original radiograms of the ramus did not reveal this condition. Our plan of treatment which was originally to place an intramaxillary splint to reduce the anterior fracture was changed on finding out the true state of affairs to an intermaxillary splint to control the posterior fracture.

(Case 2) The dental splint should be made as lightly as possible consistent with sufficient strength to hold the segments of the fracture in position. I believe that in Fig. 3 the segment could be held with two bands on the laterals instead of using four, also suggest using a lingual arch instead of a buccal and use only two premolars, lingual hooks on the laterals replacing those on the labial.

(Case 3) I think one band on the first molar with buccal extension on the segment would be sufficient or a skeleton across the palate, two bands on the opposite side.

(Case 4) The general conditions illustrate the essayist's well timed advice in regard to the necessary surgical care, not only of the oral conditions but of the adjacent structures. I would differ from his holding of this case. The attachments do not appeal to me, that is the placing of the wire through the soft tissues. I would use bands on the first premolars and bands on the first molars, solder square tubing to these two bands on either side, have an extension bar running out from the tubing to come around the angle of the mouth and turn back towards the lobe of the ear; your extension wire must be parallel with the tubing, your attachments will be in the posterior part of the bars. Your attachments can be made to the occipital portions of the head, using head gear for that purpose. The strain of attachment must be in a vertical direction.

Dr. Thomas P. Hinman.—I will say to Dr. Eby that his very complimentary introduction reminds me so much of the negro who was standing on the corner. Somebody walked up to him and said, "Uncle Jim, can you change $10?"

He looked at him and said, "No suh, but I thanks you for the compliment." (Laughter)

The question of fractures, in my judgment, should always be divided into maxillary and mandibular fractures which Dr. Federspiel has done very well. The handling of fractures is a thing that requires rather unusual ingenuity at times, and there can be no set method of handling fractures. Every case must be treated as an individual entity. I would not criticize anything Dr. Federspiel has shown because, in the final analysis, he got results, and that is exactly what we want.

I was very much interested while coming up on the train in talking to some of the young men who are practicing orthodontia as a specialty. I said to them, "Well, boys, after all some of the cases finally get a good occlusion and get straight in spite of everything you have done to them."

You will find that fractures do the same thing sometimes. (Laughter.) A fracture of the mandible, where it is not complicated, is not, as a rule, very difficult to immobilize. That is particularly true where the full complement of teeth is present and the occlusion is fair. If a man says he can immobilize every fracture, and it is where he gets perfect occlusion, he is mistaken; it can't be done. (Laughter.) The occlusion in 99.9 of your cases is not quite perfect in spite of everything. Nature will make it perfect if you will leave it alone.

The question of ingestion of food during intermaxillary wiring is one that need not give you any anxiety, because in thirty-seven or thirty-eight years I have had a few cases, and I have so far never had to extract any tooth so that the patient could eat. I want to say something that I think will interest you. There was a wonderful football player named Red Barron. Probably some of you football fans have heard of Red. He got quite a fracture of the mandible during a football game, and my associate Dr. Sibelman set that by using intermaxillary wiring, and then he fed that boy on liquids, and he continued to play football all the time; he continued to win games. You need not worry about feeding them; they will get along all right.

I think that particularly the multiple fracture in the incisor region, as shown by Dr. Federspiel, has been exceptionally well done. The question as to whether you should put one, two, three or four bands on does not amount to anything at all. It is a question of did you get results, and he evidently got results in his case.

The question Dr. Hume brings up of banding a tooth that is in close proximity to the line of fracture depends entirely on the rigidity of that tooth. Sometimes you will be very much surprised to find that that tooth is a little more rigid than you think, particularly is this true of a canine or cuspid tooth. As a rule I prefer not to do it.

As you say, every case must be treated according to the symptoms. We cannot give any set rule for anything. Of course you can't agree with everything the essayist says. I like to because I like to be pleasant and friendly, too. I must say I admire Dr. Federspiel for what he has accomplished in the realm of oral surgery. Everybody who knows of his work must do that, and that is said sincerely, Doctor.

However, I must disagree with him in the use of peroxide in any case of fracture. I think we should eliminate peroxide entirely where there is a possibility of that rather dangerous drug seeping into the wound and breaking up healing. It might do it; I am afraid of it. I would rather use a good normal saline solution. You will get equally as good results. But that is just an opinion. If you are going to attempt to set mandibular fractures, let me warn you against general anesthesia, if you are going to do intermaxillary wiring; don't use it. It is a very dangerous thing to do. With block anesthesia you can accomplish everything you want to accomplish and you can do your intermaxillary wiring just as successfully with block anesthesia as you can with general anesthesia, and you have no after dangers.

You probably remember in the early part of the very terrible war that has just passed, at the aid stations at base hospitals in France a great many of the English soldiers had fractured mandibles wired by either the intermaxillary wiring with loops or with the Gilmore method, which was shown a few minutes ago, and in coming back over the channel they became nauseated; they had seasickness. Numbers swallowed vomitus and died. You are going to have the same trouble if you give general anesthesia and do intermaxillary wiring. Be careful about that. I think it is absolutely contraindicated.

In his treatment of the maxillary fractures and passing the wiring through the cheek, he got results and had very little scar. I compliment him very highly on that. I have been unfortunate enough to have had to treat a few of these cases, and I believe that the Kingsley splint, partially described by Dr. Hume, is to my mind a better treatment—I don't know; I have never used this particular method.

The question of the use of the x-ray in handling your fractures is of extreme importance. Be sure that you get good pictures of your case, and be sure that you keep those pictures of

the case. Don't let them get away from you. You keep the pictures, and then after you have done your wiring take another picture to see if your work has been well done. You would be surprised sometimes to see how poorly it is done. I am talking about myself; I am not talking about you.

In the majority of cases I have handled (and I am not exaggerating when I say I have certainly handled not less than 700 and nearly 1,000; I haven't kept a record because I have been doing this work for just a little over thirty-seven years) I have had very few in which I had to resort to orthodontic appliance; in some cases I have had to resort to it, particularly in the fractures in the lower incisor region where a portion of the alveolar process carrying the four incisor teeth is broken, or there is a multiple fracture at the canine eminence on both sides. But if you will use the system or method of loop intermaxillary wiring you will find you can handle ninety per cent of all of your cases, and it is a simple method; it is an effective method. The advantage of it is that anyone with reasonable skill can set the ordinary mandibular fracture with reasonable results inside of thirty minutes. Anyone can do it; it is simply a question of handling the wiring. I don't believe we should go into the complicated method of handling fractures when we can do it very simply.

I do thoroughly believe, however, in all cases of fractures of the mandible that bilateral wiring or bilateral attachment is the better method although if a man succeeds with unilateral wiring, that of course is just a question of what method he wishes to apply, and if he is successful.

Gentlemen, it is very interesting to be with you. I am still like the old negro, I can't change the $10. I am not an orthodontist, but orthodontia has always appealed to me. It has been a thing that has always drawn my interest. This morning in the discussion of Dr. Casto's paper there was a good deal said about teaching orthodontia in the colleges. I am going to say, if you will permit me now, that I have been teaching for a period of something over thirty-seven years constantly, and I have watched the development of orthodontia.

I was saying to the boys a while ago that I have attended meetings of the American Dental Association and there were not as many members present at the American Dental Association as there are present in this meeting this afternoon. You have a little section of the profession here that is practicing that great specialty of orthodontia. Here we have a larger meeting than we had in the old days, before the culmination of the American and Southern Dental Society that made the National. Isn't it surprising? I want to compliment you on your interest in your work. I believe that you are beginning to solve the problems that are before you, and they are great problems, because in speaking to an artist recently, who was discussing the anatomy of the face, and he was talking about painting beautiful women and handsome men, I said, "Did you ever realize that the dentist has to be just as much of an artist as the man who makes an oil portrait."

He said, "No, I never thought of that."

I said, "We are dealing with the human face all the time. We are beautifying it or we are destroying its beauty."

You will find in your work that you cannot have any set rule about making every face look alike, because there is individuality there.

In the teaching of orthodontia in the school we have a great problem. I want to leave this thought with you: Who is going to solve that problem? You must, we can't. You are the men who have to solve that problem of teaching. You have to furnish us with teachers; we will put them in. This thing of having full-time teachers has got to come. I know of an institution that has full-time teachers, that runs its clinic from nine o'clock in the morning to five o'clock in the afternoon twelve months in the year, and every demonstrator is a full-time man and has nothing to do except that work. That is the way that institution is run.

This question of orthodontia in its relation to general practice and how much orthodontia ought to be taught a student in college, and what ought to be required of him, you have to solve, and when you do that, I believe you will find the heartiest cooperation from the colleges. Thank you very much.

Dr. Risk.—In our office we have had a number of these cases, and I have one somewhat similar to Dr. Federspiel's first case. I have the slide here which I would like to show.

In taking care of these cases, where we had most of the teeth present or where we have been able to, we have used a splint of such a nature that the patient might still have the use of the mandible. This case is an infant three and one-half years old, injured in an automobile accident. The one lower lateral incisor was lost, and the two centrals were loosened. We made this splint and cast, and took impressions in modeling compound under general anesthesia. That is the original model over which it was cast. The plan was that the tubes on the splint should line up when the parts were brought into proper relationship. The splint was also made that way so the child might have the use of the mandible. She had nausea following the general anesthesia.

Our element of error was almost negligible. A variation to this had been used in adult cases, but in the infant we felt that this type of splint was almost necessary. We have permitted the patients in all cases to have the use of the mandible when there was no fracture distal to the last tooth in good condition.

Frequently when the fracture has been in the ramus we have used traffic bands in ligating the mandible to the maxilla, and it has simplified, we thought, some of the construction of the new bands.

THE GROWTH OF THE ALVEOLAR BONE AND ITS RELATION TO THE MOVEMENTS OF THE TEETH, INCLUDING ERUPTION*

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INTRODUCTION

IN THE course of the first lectures which I delivered in 1924 in the series on the Growth of the Jaws, arranged by the Dental Board, I made some general remarks on the growth of the alveolar bone and pointed out that "the increase of the alveolar bone by surface additions leading in the maxilla to a strong downward, outward and forward movement of the alveolar arch, and in the mandible to a similar movement of less extent and somewhat different character, is important from three points of view: (1) the addition to the height of the jaws that is thereby achieved; (2) in relation to the eruption of the teeth; (3) in relation to the changing form of the alveolar arches."

The first two of these aspects of the growth of the alveolar bone I then discussed quite briefly, with a general note on the question of the movements of the teeth, erupting and fully erupted, in the alveolar bone; the third aspect, that concerning the important changes which take place in the alveolar arches during the change from the deciduous to the permanent dentition, was discussed more fully. This discussion, however, was based upon only a few observations of the actual manner in which the alveolar bone grows in the jaws of madder-fed animals, and chiefly upon all the available data concerning

*The expenses of the work upon which this paper is based have been borne by a grant from the Medical Research Council, and I am also indebted to the Research Committee of the University of Birmingham for the facilities they have afforded me. I should like also to acknowledge the willing help of my laboratory assistant, Mr. E. Sims, in the preparation of specimens.

Read before the British Society for the Study of Orthodontics.

growth changes as determined in the human jaws by measurements. I included a fairly full account of the important work of G. Franke, whose premature death in 1924 was a great loss to dental science, and I arrived at the conclusion that "the arches (of the deciduous and the permanent dentitions) are not identical, the succession is not an exactly vertical succession, the characteristic form of the deciduous arch is changed to the characteristic form of the permanent arch by growth in width of the posterior part of the arch, which takes place during the tooth change, and by the nonvertical succession of the anterior teeth; moreover, as a result of the addition to the length of the face during the period of change by general growth of the alveolar bone, the arch is entirely reconstituted and comes to occupy a new plane relative to the body of the jaw."

Franke's conception of the relation of the deciduous and permanent arches was then illustrated by two of his diagrams, again reproduced (Fig. 1), which exhibit them, (*A*) maxillary and (*B*) mandibular, superimposed one on the other. The change from the deciduous to the permanent arch is brought

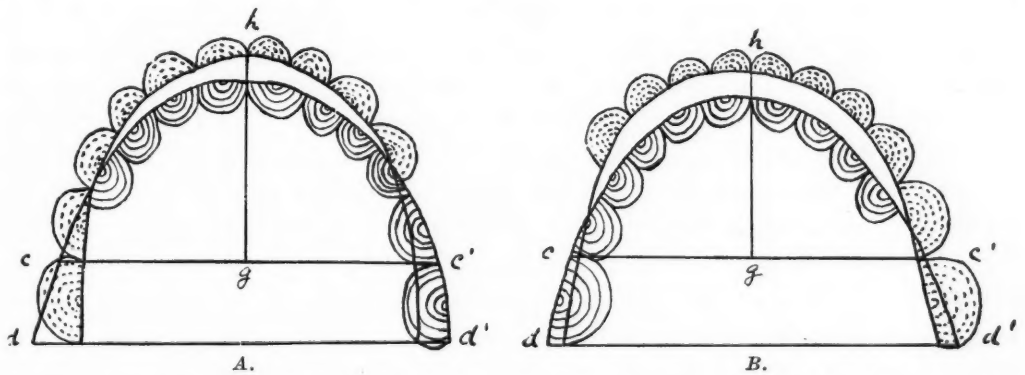


Fig. 1.—Superimposed alveolar arches, deciduous and permanent, of (*A*) the maxilla and (*B*) the mandible. The deciduous alveoli are indicated by interrupted lines, the permanent by continuous. (After Franke. Block kindly lent by the Dental Board of the U. K.)

about, according to Franke's measurements, by the increased width of the base of the arch, combined with a diminution of its "length." The "length of the alveolar arch" depends upon the sum of the measurements of the anterior ten teeth, and the decrease, which Franke found, of about 4 mm. in the mandibular and 2 mm. in the maxillary, is due to the smaller diameters of the premolars as compared with the deciduous molars in each jaw, combined in the maxilla with the greatly increased size of the permanent incisors, especially the central. "It follows that with increased width of the base of the arch and diminution of its length the arch must become flatter and the height therefore less, and since the maxillary increases more in width but at the same time decreases less in length there is a compensation and the heights remain relatively the same."

But, having given an account of Franke's work, it was pointed out that "this conception of the relation of the two arches depends entirely upon the assumption that the first permanent molars move only laterally and not at all forwards in the jaw, and that the flattening of the arch which takes place

is partly due to the widening of its base and partly to the permanent teeth occupying a position further back because, especially in the mandible, their added diameters are less than those of the deciduous teeth. While this supposition is evidently of the greatest value for the due comparison of the arches, it must be admitted that the same result would be brought about by an outward and forward movement of the first permanent molars which, although there is no sure evidence that it takes place, must be postulated if we wish to superimpose the arches by means of the incisors."

In other words, after a discussion of the important question whether there can be found a fixed point from which to take measurements of the alveolar arches and to determine the relative position of the teeth in jaws of different ages, the conclusion had been reached that in the absence, owing to growth changes, of any such fixed point on the bone itself, the first permanent molar, since in a sense it belongs to both dentitions, might conveniently be used for that purpose. It was then recognized, however, that measurements based upon that tooth or its alveolus could not be taken as evidence of actual increase or decrease from a fixed point, since there was clear proof that during the period of tooth change it moves in the alveolar border not only upwards, in conformity with the general upward growth of the border and the consequent general upward movement of all the teeth, but also outwards, as is obvious from the increase of the intermolar measurement and also from the appearances, in madder-fed animals, of the bone forming its alveoli.

Nor has there hitherto been any definite evidence adduced to settle the question whether it may also move in the alveolar bone in a proximodistal line, actually and not merely relatively to the ramus of the mandible or the malar process of the maxilla as these move backwards. It is sufficiently obvious that measurements which depend upon the position of a tooth moving certainly in two directions, and possibly at the same time in a third, must be relative only.

The object of this paper is to discuss a little more fully the whole question of the growth of the alveolar bone in the light of further experimental material, with special reference to its importance in relation to the growth of the jaws as a whole and to the movements of the teeth in the alveolar bone, including the movements which take place during their eruption.

THE MADDER METHOD

The evidence upon which I propose to base certain conclusions has been obtained by observation of the jaws of madder-fed animals, by the measurement of the actual amount of new bone laid down in different situations during given periods and by interpretation of the meaning of its distribution. It may be well, therefore, in the first place to give a brief account of the madder method and to comment on some of its difficulties, not only for the benefit of those who may be not quite familiar with it, but also in view of certain recent rather emphatic statements tending to throw doubt on its value. These statements, having been made in a paper published in the *British Dental Journal*, may perhaps have led some who are interested in the problem of the growth of the jaws to discount the conclusions at which those

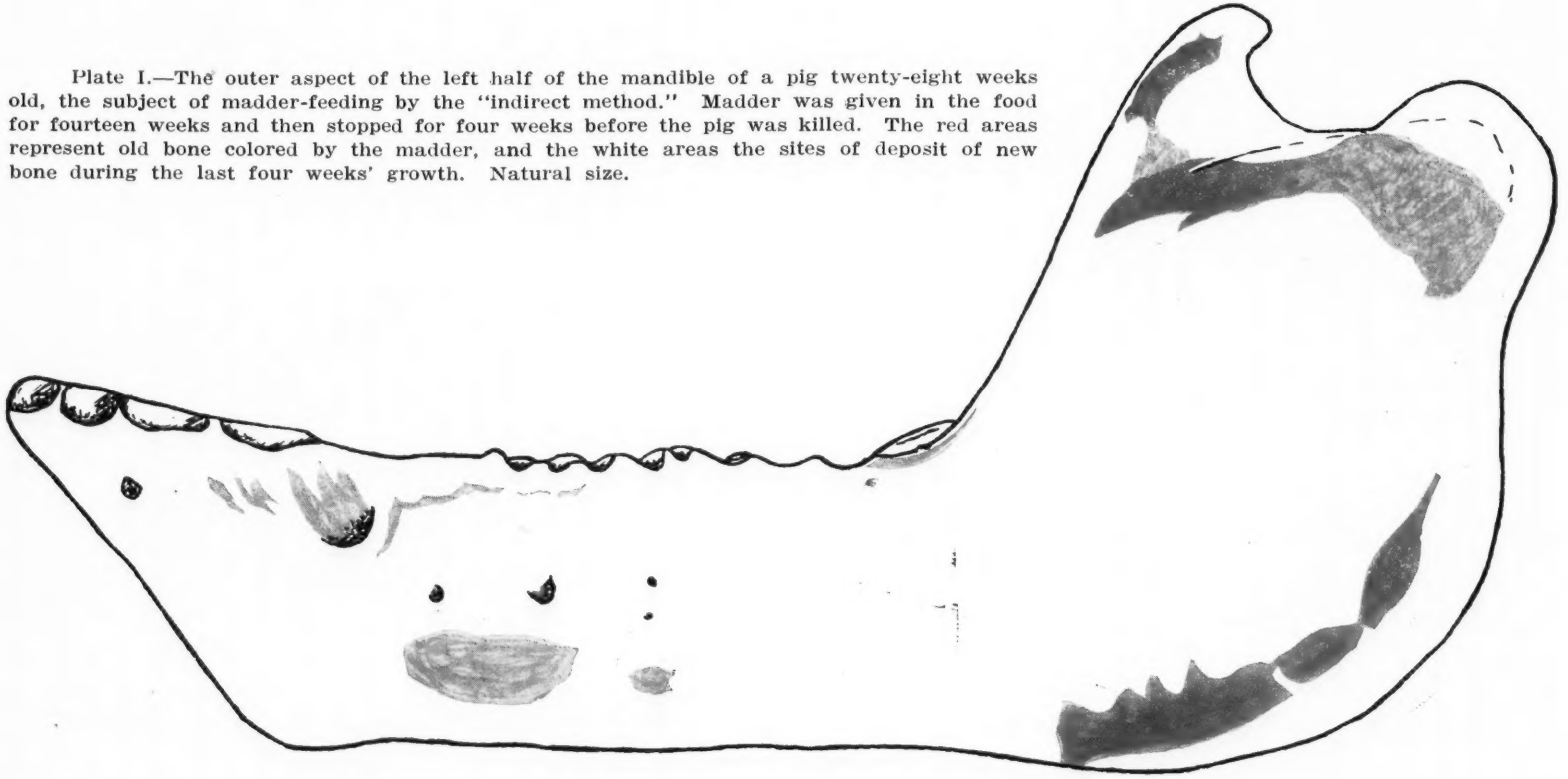


Plate I.—The outer aspect of the left half of the mandible of a pig twenty-eight weeks old, the subject of madder-feeding by the "indirect method." Madder was given in the food for fourteen weeks and then stopped for four weeks before the pig was killed. The red areas represent old bone colored by the madder, and the white areas the sites of deposit of new bone during the last four weeks' growth. Natural size.

who employ the method are arriving. I do not intend, however, to deal here with these criticisms, to which a detailed reply has already appeared in the same journal; I shall content myself with a simple statement of the principles, the difficulties and the value of the method.

I omit also any historical references, having already given elsewhere a short account of the origin and progress of the application of the properties of madder to the study of the growth of bones. Briefly stated, the principle is that when madder (the ground root of the madder plant, *Rubia tinctorum*) is administered with the food in suitable quantities to suitable animals, the bones acquire a red color. This color is found to affect the whole of the bone, but is deeper in the growing parts: the sites of the growth of the bone may therefore be recognized after a suitable period of "madder-feeding" by the presence of the deeply stained layers. With this "direct method," however, since the old bone is at the same time slightly colored, the line of demarcation is not particularly sharp, and it has been found that considerably better results are to be obtained by an "indirect" procedure. First, it is insured that the bone is deeply stained throughout by giving madder continuously, preferably from birth, for a sufficient time, and then it is omitted for any period during which the growth of the bone is to be determined. Any excess of madder in the circulation appears to be very rapidly eliminated, principally by the kidneys, and the new bone laid down during the "nonmadder" period remains uncolored and is thus marked off very sharply indeed from the previously colored bone. The invariable results obtained with the same bone at the same stage of growth demonstrate the reliability of the "indirect method," which I now always employ.

There are, however, certain difficulties in the way of correct interpretation of the results obtained; these difficulties, which I do not propose to discuss here in any detail, render it necessary, in the first instance at any rate, to use an animal with sufficiently large bones to enable the observer to distinguish easily between the different areas of growth, and to interpret correctly the changes from red to white areas. The larger the animal also, the more accurate will be the measurement of growth increments.

There are five sources of difficulty in the use of the madder method. The first, that with the "direct" method the line of separation between new and old bone is not sharply marked, is entirely overcome by the use of the "indirect." But the indirect method itself, although the line of demarcation is very sharp, introduces further questions, entirely concerned, however, with the measurement of the amount of new bone and not at all with its distribution. In the first place, the exact time necessary for the elimination of circulating madder, although certainly very short, is unknown; it may therefore be that the bone continues to be colored for a short time after the madder has been withdrawn. But, on the other hand, it is to be observed that the growing areas of an animal killed during a madder period exhibit a very thin pellicle of feebly stained, because incompletely ossified, bone. Without discussing these two possible sources of error in opposite directions in measuring the thickness of new bone, I may say that, whether they may cancel each other or not, owing to the exceeding sharpness of the transition from old red

to new white bone, and in view of the certainty that a difference resulting from either of them must be extremely minute, they may safely be neglected.

The fourth source of difficulty is that, owing to the amount of absorption proceeding all over the skeleton during its growth, some of the madder already deposited in the bones is set free into the circulation, and this appears to be sufficient, in spite of rapid elimination, to impart a very slight creamy tinge to the new bone as it is laid down. But this fact constitutes no "difficulty" at all, as the tinge is never sufficient to interfere in the very slightest with the sharp line of demarcation between "maddered" and "nonmaddered" bone; it is of no importance whatever, so far as interpretation or measurement is concerned.

Lastly there is the problem of interpreting the areas which remain red after a nonmadder period. On this point I need only say that there are several means of determining how far these areas represent stationary surfaces, and how far they are accounted for—and this is the explanation of the vast majority—by the process of absorption.

All the difficulties in the way of the interpretation of the results obtained by the madder method being appreciated and duly taken into account, it remains the most powerful instrument for the discovery of the mode of growth of bones, including the actual and relative extent of deposition and absorption at any part of the skeleton, and I may add, the relation to the growth of the skull of the synchondroses and sutures which unite its various component bones.

I may not note here that in the course of a recent experimental investigation of the vitamine content of madder, carried out in cooperation with my colleague Professor Haswell Wilson, on a considerable number of rats, we have also taken the opportunity of testing different preparations of the two main coloring principles, alizarin and purpurin, which are contained in the madder root. We have arrived at certain conclusions, which we hope shortly to publish in a paper on the vitamine content of madder and the relation of its chemical composition to its staining properties. Briefly, we find that the vitamine content of commercial madder, as supplied to us, is negligible, this conclusion opening the way to experiments on animals with deficiency diets combined with madder, and that, whereas both alizarin and purpurin are efficacious alone in staining the bones, purpurin is the more powerful, contrary to the received opinion that it is to the alizarin that the madder root owes this property. The purpurin content of madder is therefore believed to be the more important from this point of view, although alizarin is the substance which gave to madder its commercial value as a dyestuff; it was the production of alizarin artificially—the first of the vegetable dyestuffs to be synthesized by the German chemists, Graebe and Liebermann, in 1869—that gradually led to the great restriction of the madder industry.

THE GENERAL PRINCIPLES OF THE GROWTH OF BONE

Before we proceed to the consideration of the growth of the alveolar bone in detail, the general principles of the growth of bone, as demonstrated by the madder method, may be summarized as follows: In the first place,

there is no evidence of the growth of bones in size by interstitial deposit, although interstitial changes, by deposit and absorption, undoubtedly occur. Thus, compact bone may be changed to cancellous, or the process reversed, without the least effect upon the space occupied by the piece of bone concerned. Apart from the ossification of cartilage, in such situations as the epiphyseal lines, articular surfaces or the synchondroses of the base of the skull, all increase in the size of bones, or in the thickness of any part of them, is due to the deposit of new bone on their free surfaces, either external or internal. All changes in the shape of bones, as well as the retention of form by the maintenance of the relative position of different points as increase in size takes place, are due to a combination of surface deposit and surface absorption which in all parts of the skeleton proceed simultaneously. This includes the enlargement of cavities, such as the marrow cavities of long bones and the air sinuses in the skull. The chief rôle of absorption is found in the maintenance of the general form of a bone as it grows in size; compelling examples of this process are to be found not only in the moulding of the long bones as they grow in length, but also in the growth of the mandible and maxillae. Compare the expanding growth of the shaft of the femur, which increases so much in diameter by external deposit and internal absorption that a specimen from a newborn child may be placed inside the medullary cavity of an adult bone, with the great increase of the surface area of the maxilla combined with the increasing capacity of the antrum within it. The general increase in size of the cranium, and in its capacity as the brain grows, provides another excellent illustration, resembling in essentials, like the growth of the maxilla, the increase in circumference and in the cavity of the shaft of the femur; the changes that take place in the skull, however, are complicated by the question of the relation of the sutures between the different bones to the growth of the whole.

Surface deposit and surface absorption are therefore the means by which bones grow in size and change their shape, and it is to the application of these principles to the growth of the alveolar bone that I now proceed. I propose to deal in turn with each of the three aspects of alveolar growth to which I have already referred; considering in the first place the increase in height of the jaws as a whole; secondly the movements of the teeth in the alveolar border, including their eruption; and finally referring briefly to the importance of the conclusions reached for our conception of the changing form of the alveolar arches.

THE RELATION OF ALVEOLAR GROWTH TO THE GENERAL GROWTH OF THE JAWS

The general dependence of the form of the alveolar border upon the presence of the teeth, and the association of bone growth in this region with their eruption have long been commonplaces of observation. "It is impossible to insist too strongly upon this fact," says Tomes, "that the sockets grow up with and are moulded around the teeth as the latter elongate. Teeth do not come down and take possession of sockets more or less ready-made and preexist, but the socket is subservient to the position of the tooth; wherever the tooth

may chance to get, there its socket will be built up round it. Upon the proper appreciation of this fact depends our whole understanding of the mechanism of teething."

But it has to be recognized that all the changes which take place in the alveolar border have generally been considered to be local changes only, the series of events comprising the building up of milk sockets, the replacing of these by permanent sockets and the final absorption of the latter in their turn constituting the history of an alveolar border which remains the same border throughout. Tomes again sums up this view in a well-known passage in the *Manual of Dental Anatomy:* "We may now revert to the phenomena observed in the alveolar processes. They were first built up as crypts with overhanging edges enclosing the temporary teeth; then they were swept away, in great part, to allow of the eruption of the temporary teeth; and next they were rebuilt about their necks to form their sockets. Once more, at the fall of the deciduous teeth, the alveoli are swept away, the crypts of the permanent teeth are widely opened, and the permanent come down through the gaping orifices. When they have done so, the bone is reformed so as to closely embrace their necks, and this at a period when but little of the root has been completed."

There is a little suggestion here that the alveoli which are "swept away" at the fall of the deciduous teeth are not the same alveoli that were previously "built about their necks to form their sockets," or that in general all these changes, described with accuracy in a relative sense, are taking place in an alveolar border which as a whole, in spite of local absorptions, is steadily growing throughout. While undoubtedly in other passages in his account of the general growth of the mandible Tomes infers that there is considerable growth in height of the alveolar border—even to the extent of stating that in his opinion the deepening of the alveolar portion of the jaw "constitutes almost the whole increase in vertical dimensions during the passage from the child's to the adult's form of jaw"—yet these statements must be read in the light of his conception that the alveolar and basal portions of the jaw are always distinct, and separated by a line which he draws on the basis of the dental canal and mental foramen. The impression that is left on the reader is that the dental canal itself does not change, that the history of the parts above and below it is quite different, and that the growth of the alveolar border is limited to providing for the greater length of the roots of the permanent teeth.

It has indeed been recognized by some lately that the occlusal plane is constantly undergoing an alteration of level throughout the growth period, but the tendency is to ascribe this to the growth of the bones of the skull, so that the occlusal plane is "thrust downwards and forwards" to a lower level.

I make this introduction because I propose to show that the growth of the alveolar border is a very important factor in the increasing height of the jaws, that its activity is by no means limited to building up the alveoli for the teeth and providing for the greater length of root of the permanent teeth, and that the true change in the occlusal plane, so far as the bone is concerned, is not a mere alteration of level in relation to the base of the skull, but consists in a continuous alteration from both maxillary and mandibular sides by constant additions to the actual surfaces of the alveolar borders. Local changes

there are in consequence of the eruption of the teeth, but they do not interfere with the constant change in the level of the border as a whole; this I hope to demonstrate by actual measurements of the rise of the alveolar borders in the jaws of the pig.

If we examine the mandible or maxilla of a growing pig which has been the subject of madder-feeding by the indirect method, then we shall find that the whole of the alveolar border, irrespective of the state of the eruption of the teeth, will show the white edge that denotes bone growth (Plate II and Fig. 2). Moreover, where teeth are erupting, the local absorption which is taking place is seen to affect as a general rule only the outer wall of the crypt, leaving the inner wall to maintain the general continuity of the rising level of the border, a process which cannot be accurately described as a "sweeping away" of the alveoli or of the border. Here then is evidence of the constant upward growth of the alveolar border as a whole, and a closer examination

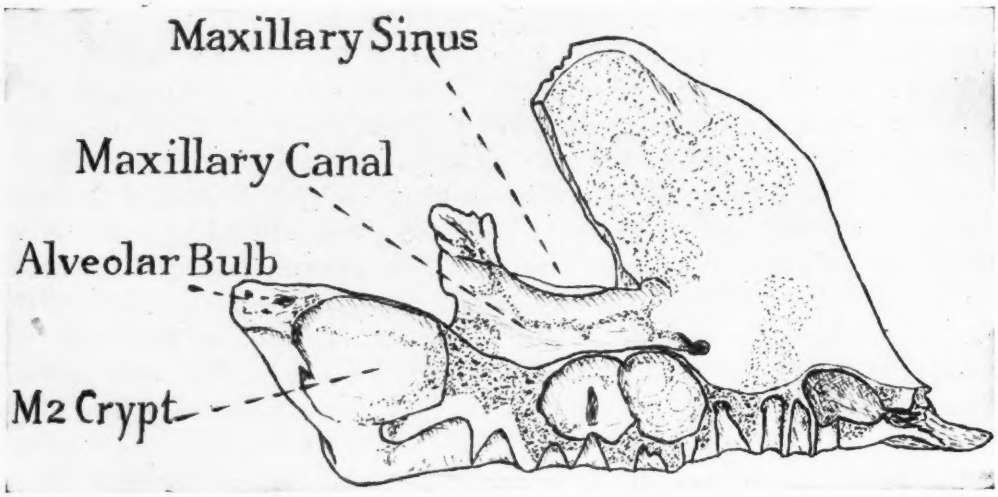


Fig. 2.—Sagittal section of the right maxilla of a pig twenty-four weeks old, to show the relation of the maxillary canal and the floor of the maxillary sinus to the alveolar border, and the growth of the alveolar edge. The stippled areas represent old bone, and the white areas new bone, laid down during a period of four weeks. Natural size. Cf. Figs. 5, 6, and 7.

reveals that new bone has been added not only on the surface of the border itself, including the outer and inner edges and the edges of the interalveolar septa, but also on the walls of all the alveoli. For the moment we are concerned only with the growth of the edges; the new bone formation in the alveoli will be considered later in relation to the movements of the teeth in the growing border.

The growth of the alveolar border leads therefore directly to an increase in the depth of the bodies of the mandible and the maxilla. The problem in the mandible is to determine to what extent it is responsible, as compared with additions to the lower border, for increase in the depth of the body as a whole; from this point of view the position of the mandibular canal may be safely neglected and the whole difficulty of finding a "fixed line" avoided, since we are in possession of the means to measure the respective increments directly. In the maxilla, on the other hand, the problem is to determine to what extent

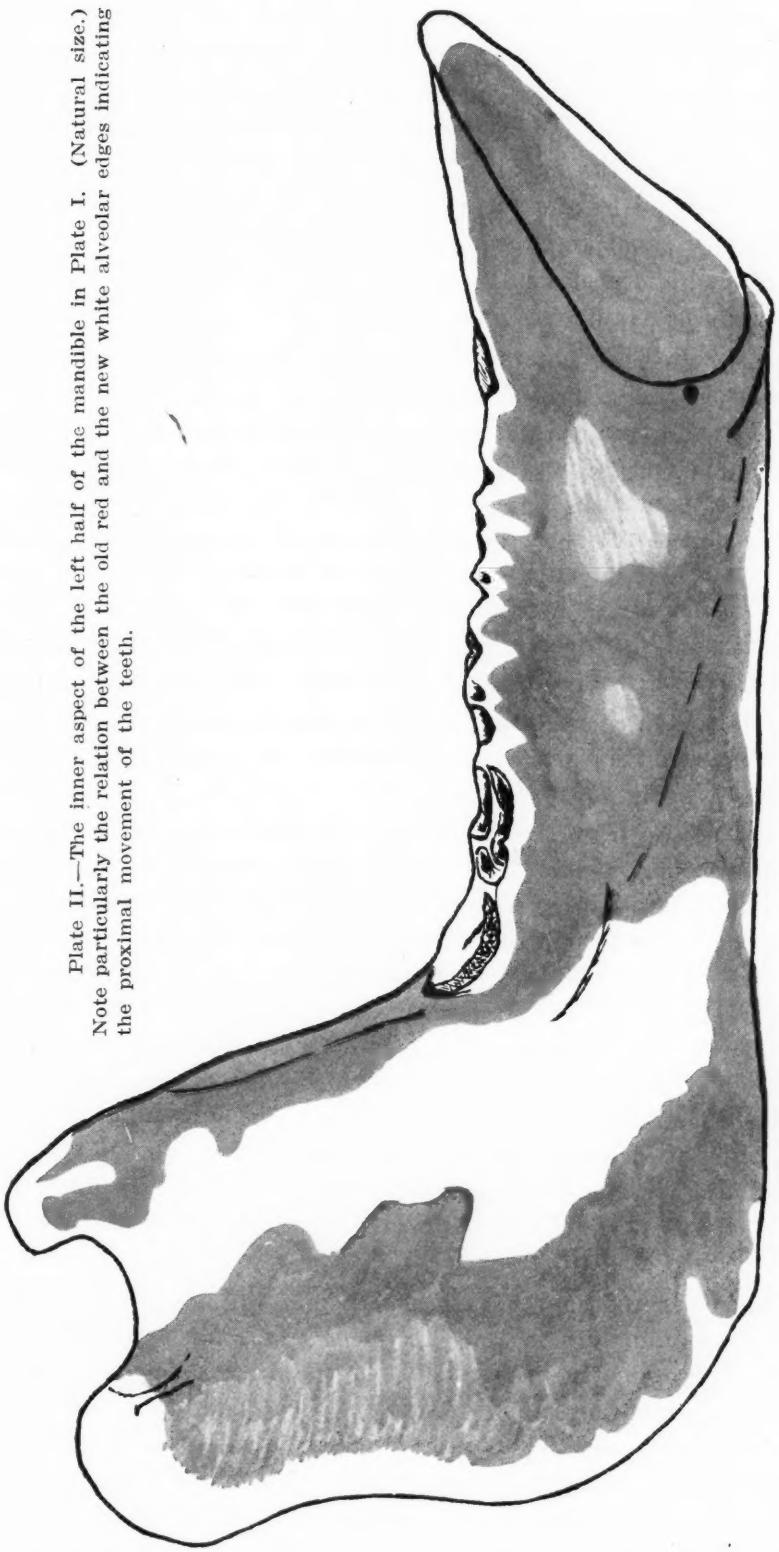


Plate II.—The inner aspect of the left half of the mandible in Plate I. (Natural size.) Note particularly the relation between the old red and the new white alveolar edges indicating the proximal movement of the teeth.

the growth of the alveolar border is responsible for the similar increase in the depth of the body, as compared with growth at the cranial side of the bone —a question that is complicated by the articulation of the maxilla with other bones of the skull and by the presence of the superior maxillary canal, which in the pig's maxilla lies below instead of above the maxillary sinus as in the human bone, and of the maxillary sinus itself (Fig. 2). On account of the difficulty introduced by the sutural connections above, the growth directions of the maxillary canal and the maxillary antrum have to be considered from the beginning, but the difficulty is more than balanced by the advantage of the extra surfaces available for observation.

We may note here that the structure of the maxilla and of the mandible is essentially the same; in each there is a cavity in relation to which the nerve supply of the teeth runs: in the one the cavity is occupied by air separated from the bone by mucoperiosteum, in the other by fatty marrow separated from the bone by endosteum. In the human skull the ultimate position occupied in each by the nerve may perhaps be taken as an index of the proportion contributed by alveolar growth to the ultimate depth of the bones. The growth history of the mandibular canal, however, does not immediately concern the present part of the subject, though certain observations, confirmatory of the conclusions drawn from direct measurements, will later be mentioned.

So much for a general statement of the continuous growth of the alveolar border. What can we learn as to the amount and rate of the growth by actual measurement?

The procedure has been as follows: Projection drawings for subsequent use having first been made of different aspects of the mandibles and maxillae of madder-fed pigs, a large number of preliminary measurements was taken, including approximate determinations of growth increments wherever possible. The left halves of the mandibles and the left maxillae were then sectioned with a fine fret-saw into twenty to thirty pieces each, mostly at right angles to the alveolar border, and all growth increments measured on the cut surfaces. The right halves of the mandibles and the right maxillae were in the first instance retained intact as controls, to be subsequently sectioned, the half mandibles by a frontosagittal cut, passing through all the alveoli, into buccal and lingual portions, and the maxillae in the horizontal plane, separating the alveolar border and exposing the walls of the maxillary canal and sinus.

All measurements have been taken with a sliding gauge, provided with a vernier scale reading to 0.1 mm. The actual readings have been recorded in every case, although it is recognized that the error of observation in making measurements depending upon transition from red to white bone, especially on curved surfaces, may amount to more than one-tenth of a millimeter. The growth increments on the roots of all the teeth which show them from both sides of each jaw have also been measured, and as far as possible the depths of all the alveoli; note has also been taken of the progress of absorption of the roots of the milk teeth in the later stages. I have also considered the question, and made some measurements, of the apparent additions to the

height of the bodies of the mandible and maxilla by the growth of their non-alveolar borders, though this is by no means so simple as it may appear.

The data so obtained have enabled me in the first place to calculate the individual and average rates of the growth of the alveolar bone, to come to a conclusion regarding the proportions contributed to the height of the jaws by alveolar and other growth, and to compare the increase in the height due to alveolar growth alone with the simultaneous increase or diminution by absorption in the length of the teeth themselves and the increase or decrease in the depths of the alveoli. I have also been able to compare the distances traveled by the crowns of erupting teeth with the simultaneous increases in the lengths of their roots. The data derived from all the mandibles and maxillae available from madder-fed pigs, though still very far from complete, are already much too extensive to print here in full; it is hoped to publish them later in the first of a series of "Studies on the Growth of the Skull." In the meantime all that can be attempted is to present a few typical measurements illustrative of the general conclusions to which the full series increasingly points.

BONE ADDITIONS TO THE MANDIBULAR ALVEOLAR BORDER OF THE PIG FROM THE TENTH TO THE THIRTY-SECOND WEEK

Selecting three mandibles at intervals during this period, Nos. 15, 12, and 2, from pigs of 13, 20, and 28 weeks respectively, I find that the vertical growth which has taken place in different regions of the alveolar border is as set out in the following table. It is to be noted that in Table I and the subsequent tables the figures for Nos. 12 and 2 represent four weeks' growth, whereas in No. 15 two weeks only had elapsed since the madder was stopped.

It will be noticed that the amount of addition to the alveolar border, at its maximum in the incisor region, diminishes in general towards the ramus; the increase in sections 13, 14 and 15 of No. 12 is related to the state of eruption of the first permanent molar. Table I gives the acutal amounts added in the periods stated, and a calculation of the rate at which the alveolar bone is growing shows that it ranges in these pigs from a minimum of 0.2 mm. to a maximum of 3 mm. per week. It should be pointed out, however, that the minimum occurs on the center of the edge of the alveolus of the first permanent molar in No. 2, and that approximately double the growth has taken place immediately in front and behind this point; this indicates a levelling up of the alveolar edge in the later stages of the eruption of the tooth. The average growth of the alveolar edge in these three pigs is at the rate of 0.875 mm. per week, which it may be noted, as a matter of interest not without its importance for the study of the growth of the mandible as a whole, is rather more than half the rate at which the posterior border grows backwards.

THE RELATION BETWEEN THE GROWTH OF THE ALVEOLAR AND THE LOWER BORDERS OF THE MANDIBLE IN THE PIG

If we now turn to the lower border of the mandible and measure the additions there in the same sections, we find a rather unexpected and very dif-

ferent state of affairs. Unexpected as they are, the facts of the amount and distribution of growth on the lower border of the mandible are of the highest importance for a correct conception of mandibular growth as a whole.

The gap in the measurements of the lower border, opposite the alveoli from the third incisor to the anterior alveolus of the second deciduous molar, is due to the much greater extent of the alveolar than the lower border in that region. As a result of the spreading curvature of the anterior part of the alveolar border in the pig's mandible, the same point on the lower border is "opposite" several alveoli, related to them as the center of a circle to its circumference. The corresponding alveolar measurements are therefore omitted in the calculation of the percentage increases due to alveolar and lower border growth, so that these may be placed on an equal basis.

Without detailing the rates at which new bone is being added to the lower border, though they are obviously much smaller than at the alveolar

TABLE I

GROWTH INCREMENTS IN THE ALVEOLAR AND LOWER BORDERS OF THE MANDIBLE OF THE PIG

	ALVEOLAR BORDER			LOWER BORDER		
AGE OF PIG PERIOD OF GROWTH	NO. 15 13 WKS. 2 WKS.	NO. 12 20 WKS. 4 WKS.	NO. 2 28 WKS. 4 WKS.	NO. 15	NO. 12	NO. 2
Sections						
1. i1	4.8	6.6	2.6	Nil	Nil	Nil
2. i2	6.0	6.1	2.5	Nil	Nil?	Trace
3. i3	3.7	4.9	1.4	—	—	—
4. c	4.1	3.7	2.0	—	—	—
5. dm1	4.6	2.0	1.6	—	—	—
6. dm2. ant.	2.7	3.3	2.4	—	—	—
7. dm2. post.	2.7	3.3	1.8	0.1	1.0	0.4
8. dm3. ant.	3.9	3.5	1.4	0.1?	1.5	0.6
9. dm3. post.	2.9	3.7	2.0	0.1?	1.3	0.7
10. dm4. ant.	2.1	3.5	1.4	0.2	1.2	0.5
11. dm4. cent.	1.2	3.3	1.1	0.2	1.5	0.4
12. dm4. post.	1.0	3.0	1.2	0.2	1.3	0.5
13. M1. ant.	1.9	4.9	1.1	0.2	0.9	0.4
14. M1. cent.	1.9	4.9	0.8	0.2	0.9	0.3
15. M1. post.	0.9	4.9	1.7	0.2	0.6	0.4

border, it will be sufficient to give a table to show the highest, lowest and average percentages which are contributed to the growth in height of the body of the mandible at these two sites. An accurate calculation of the varying rates of growth at these opposite sites in relation to all the alveoli at different ages will require a much larger series of specimens than is yet at my command. The further question of an exact correspondence between rates of growth as so determined and comparative dimensions of jaws of different ages is also complicated by the great variation which is found, both in rates of growth and actual dimensions, in the mandibles of pigs of the same age and from the same litter—a commonplace of observation among breeders, so far as general growth is concerned. It is not yet possible for me to make this comparison, and thus to demonstrate a correspondence and therefore the reliability of my measurements of growth increments, except in a very general way.

The two tables, however, undoubtedly demonstrate, in the first place and on the face of the figures alone withont any comment by way of interpretation of the meaning of the actual distribution of the lower border additions, that the alveolar growth is mainly responsible for the increase in height of the body of the mandible.

TABLE II

THE RELATIVE CONTRIBUTIONS OF ALVEOLAR AND LOWER BORDER GROWTH TO THE HEIGHT OF THE BODY OF THE MANDIBLE

PIG NO.	ALVEOLAR BORDER			LOWER BORDER		
	MAXIMUM	MINIMUM	AVERAGE	MINIMUM	MAXIMUM	AVERAGE
15	100+?	81.8	92.5	0–?	18.2	7.5
12	100+?	68.8	82.5	0–?	31.2	17.5
2	100+?	70.0	88.7	0–?	30.0	11.3

These calculations tell us that the growth of bone at the alveolar border of the pig's mandible from the tenth to the twenty-eighth week is so important for the general increase in the height of its body that in different regions and at different times it contributes from 70 to 100 per cent as compared with 0 to 30 per cent contributed by the lower border, and we must conclude that on the average the alveolar border grows at least seven times as fast.

But that is not the whole story. I have in these calculations taken no account of the reasons for individual variations, and have, in fact, loaded the case against the alveolar border by deliberately including No. 12, in which the lower border growth is the greatest in the whole of my series, and excluding others of about the same age in which it is much less. The considerable amount of lower border growth in No. 12 is associated with a marked difference in its contour from that which is found in most others; instead of resting securely on the table on anterior and posterior points, this mandible rides, or rather rode before it was sectioned, on very strong ridges of bone beneath the first molars and immediately in front of the emphasized preangular notches. This peculiarity obtruded itself upon my attention when I had to stabilize this mandible before making a projection drawing, a circumstance which led me to seek for an explanation.

The discovery of a reason for the exact distribution of new bone along the lower border of the pig's mandible, and the explanation of the occasional presence of a convexity there instead of the usual concavity, a peculiarity which has its counterpart in the human bone, are so vital for an understanding of the growth of the mandible as a whole, not only in relation to its general form, but also from the point of view of bone mechanics and the possible control of growth, and moreover of such immediate concern in estimating the real extent of alveolar growth, that I must here briefly outline the conception which I have formed as the result of a detailed study of points which at first sight are of little importance. Much of what is said will apply equally well to the human mandible.

The points upon which the pig's mandible rests, when it is placed on the table, are usually in the vicinity of the symphysis and the rounded angle

(Fig. 3). As growth proceeds these points move forwards and backwards respectively by extension to the lower border, and no further, in these regions of the anterior surface and posterior border growth areas. Between these points the lower border as a rule curves upwards, gradually in front behind the symphysis, abruptly behind at the preangular notch. Now the position of the preangular notch is constant, relative to the lower end of the internal oblique line and the sloping anterior border of the coronoid process. This relative position the preangular notch maintains throughout the growth of the jaw, and like innumerable other examples of bone modelling to maintain relative position, it travels backwards by a slight absorption of the newly-formed angle bone, followed by the posterior growing edge of the new bone on the lower border. Behind the symphysis on each side there is likewise a small area of absorption, to which the anterior growing edge of the lower border new bone also extends. The point upon which the jaw rests in front thus travels forward with its general growth, though to a smaller extent than the backward travel of the posterior point.

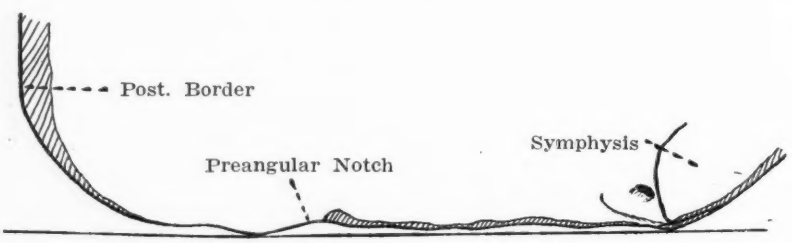


Fig. 3.—Outline of the lower border of the left half of the mandible of a pig to show the points on which it rests and the position of the growing areas. From a pig twenty-four weeks old, the surface areas covered by new bone being indicated by cross lines. It should be noted that the depth of the lined portions does *not* correspond to the thickness of the new bone added. x⅔.

The new bone on the lower border of the mandible, which it should be noted extends on to it from the outer surface, is therefore distributed solely between the anterior and posterior ends of its concavity but reaches neither. Place the mandible on the table and it will be seen that the whole area over which new bone is being added, except at the anterior and posterior points of contact, is above its level. The points upon which the mandible rests therefore travel forwards and backwards, though at different rates, followed by their respective depressions and the advancing edges of the new bone. It follows that the new bone that is seen on the lower border is to a large extent merely reforming its contour by replacing bone which has previously been removed. This is certainly the case behind where the thickest part of the new bone on the lower edge is always found to end abruptly in front of the preangular notch, and if the edge be examined from below it is a very striking fact that the lingual edge of the new bone, advancing from the outer surface, crosses the lower border from before backwards in a very oblique and almost spiral curve, so that it merely reaches the lower border in front but covers it entirely behind (Fig. 4). There is, therefore, as growth

proceeds a gradual flattening of the curvature of the lower border of the mandible as the arc lengthens, so that there is always a trifle being added to it for this reason, apart from the backward movement of the preangular notch. This amount may in some specimens, as in No. 12 and, as already pointed out, in the "see-saw" type of human mandible, be increased for reasons connected with the general form of the bone and particularly the angle between the ramus and the body, which itself varies with age, but in general we must conclude that the forward and backward growth of the mandible, without addition to its height at either symphysis or angle, is solely responsible for the amount and the peculiar distribution of the new bone on its lower border. It follows that there is no real addition at all from this source to the height of the body.

Such a conclusion is, of course, opposed to conceptions which have long held the field, but, as I find it increasingly confirmed by numerous details of observation and other lines of argument, I believe that it is true. The backward travel of the preangular notch and the lengthening with consequent

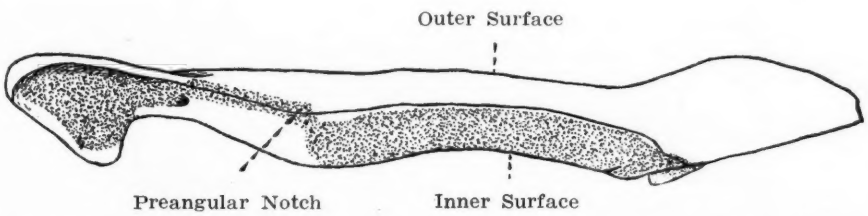


Fig. 4.—The lower border of the right half of the mandible of a pig twenty-four weeks old, to show the distribution of new bone and its relation to the growing outer surface. The stippled areas represent old bone, and the white areas new bone laid down during a period of four weeks. Note the new bone extends from the outer surface to the lower border but ends abruptly in front of the preangular notch. x⅔.

flattening of the arc of the lower border of the mandible with their relation to the general growth of that bone are, however, beyond the present subject. This is but one of a number of results that have led me to take a new view altogether of that apparently settled question, and I need only say that it will be again carefully considered in greater detail when I deal, as I hope to do at an early date, with the growth of the mandible as a whole.

Meanwhile, if it be true that the lower border takes what is practically no share at all in the growth in height of the body of the mandible, we are compelled to form what is undoubtedly an entirely new conception of the nature and rôle of the alveolar bone. If the whole of the growth in height takes place at the alveolar edge, then it follows that bone originally on this surface becomes incorporated in the basal part of the body, and that the dental canal extends into it. There is, therefore, no essential difference between alveolar bone and the bone of the base, because the former becomes progressively transformed into the latter. We shall see in a moment the comparison that is to be made with the extension of the maxillary canal and the antrum into the maxillary alveolar bone.

BONE ADDITIONS TO THE MAXILLARY ALVEOLAR BORDER OF THE PIG FROM THE TENTH TO THE THIRTY-SECOND WEEK

The measurement of additions of new bone to the alveolar border of the maxilla, leading to an increase in its height, is a little more difficult than in the mandible. There are two reasons for this. In the first place, the rate of growth in this direction is not so great, and secondly the downward increment is masked to a considerable extent by the comparatively large outward growth. It is with some reserve, therefore, that I give a series of measurements, although these have been made with as great accuracy as possible after very careful sectioning. These measurements have been taken from the left maxillae of the same three animals, and although there may be a considerable error of observation, there can be no doubt at all of the general result relative to the amount of growth in the corresponding mandibles. I therefore give them in order to demonstrate that the maxillary alveolar border is also growing downwards as a whole throughout the period covered, and that it does so at a slower rate than the mandibular.

TABLE III

GROWTH INCREMENTS IN THE MAXILLARY ALVEOLAR BORDER OF THE PIG

SECTIONS	NO. 15	NO. 12	NO. 2
1. i1	1.0	2.7	1.0
2. i2	0.7	2.3	1.2
3. i3	0.5	1.5	0.8
4. c	1.3	2.5	1.0
5. dm1	0.7	2.4	0.6
6. dm1-2	—	1.9	—
7. dm2. ant.	0.5	1.5	0.6
8. dm2. post.	0.5	1.3	0.8
9. dm2-3	0.5	—	0.7
10. dm3. ant.	0.3	1.1	1.3
11. dm3. cent.	0.6	1.9	0.9
12. dm3. post.	0.6	1.5	1.1
13. dm3-4	0.2	1.3	—
14. dm4. ant.	—	1.6	0.8
15. dm4. cent.	0.4	1.3	—
16. dm4. post.	—	1.9	0.9
17. dm4-M1	0.2	—	0.4
18. M1. ant.	—	3.9	0.7
19. M1. cent.	—	4.4	—
20. M1. post.	—	3.9	0.9

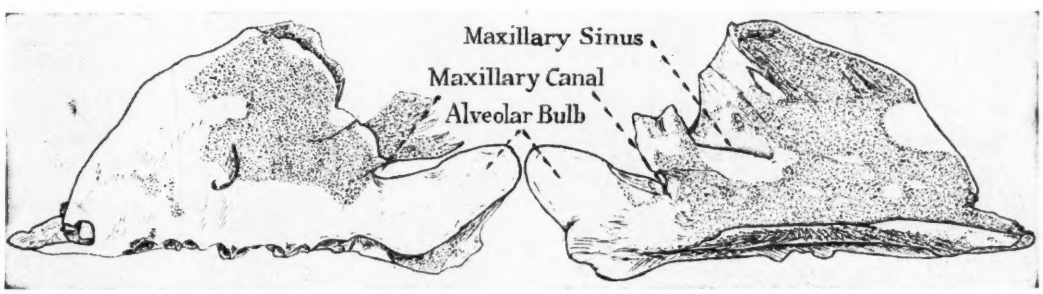
The same remark as in the case of the mandibular series is to be made on the general distribution of the growth; the maximum is in the anterior region, leading as in the mandible to forward extension of the jaw by addition to its edge in the direction in which it points; and there is again an increase in the region of the first permanent molar in No. 12 on account of the state of eruption of that tooth.

Calculation of the rates at which the alveolar bone is growing in different regions shows that the minimum is 0.1 mm., the maximum 1.1 mm. and the average in these three pigs 0.37 mm. per week. These figures, compared with the corresponding rates for the mandibles of the same animals show that the same process is at work at something less than half the rate.

As I have already indicated, these observations of the downward growth of the maxillary alveolar border are complicated to a greater extent than in the mandible by outward growth and the consequent labial changes in the position of the teeth. This point I shall refer to again in considering labial movements; in the meantime we may take it as certain that there is a steady downward growth of the maxillary border.

THE RELATION BETWEEN THE GROWTH OF THE ALVEOLAR AND THE SUTURAL BORDERS OF THE MAXILLA IN THE PIG

It now becomes of importance to turn to the other, articulated, margin of the maxilla to see if we can detect growth there and the amount of it, and to institute a comparison with the lower border growth of the mandible. I confess that the difficulties of observation on this point are at first very great, on account of the complicated articulations of the maxilla in the pig. It is, indeed, apparently quite clear in the skull as a whole that the upper border, articulating with the premaxilla, nasal and frontal in front, the lachrymal and the malar behind, is a growing edge; separate the bone, however,



A. *B.*

Fig. 5.—The left maxilla of a pig thirty-two weeks old, *A* outer, *B* inner surface. To indicate the method by which the facial surface and the maxillary sinus move backwards by external absorption and internal deposit of bone, and the corresponding upward and backward movement of the sutural border upon other bones without any downward translation of the maxilla as a result. The stippled areas represent old bone, and the white areas new bone laid down during a period of four weeks. Points in the structure of the bone are also to be observed. Cf. Figs. 2, 6, and 7. x½.

from those with which it articulates, and the appearance of the suture surface is such that it becomes a question whether the true process that is at work is not a reformation of the edge and of the sutures themselves as the facial bones expand by surface additions (Fig. 5, *A* and *B*). The fact that the surface of the maxilla itself is being excavated by absorption below the line of its sutures is also to be taken into account. This surface travels backwards by bone addition inside and absorption outside in general conformity with the lengthening of the face and the backward travel of the malar process as the molar teeth erupt; it is more than probable that there is a corresponding movement of the sutures which unite the maxilla to other bones.

Here we enter the difficult and debatable ground of the relation of sutures in the skull generally to the growth of the individual bones and of the skull as a whole. This I cannot discuss at present, but the position to which the evidence of madder specimens is slowly bringing me is this—that

growth at sutures, in the sense of separating bones which remain in the same plane, does not in fact take place at all; what appears to be separating growth is in reality a movement of the sutures by growth changes of bone deposit and bone absorption on opposite sides of the surfaces through which they pass. In this way the edge of one bone may change its position in relation to the surface of another without any separation of the bones as a result.

The articulated margin of the maxilla in the pig is, I believe, an example of this process, and although these suggestions are put forward at present in quite a tentative way, the conclusions to which they lead—that growth at the articulated margin of the maxilla results merely in an upward travel of that margin upon the bones with which it is in contact and not at all in any

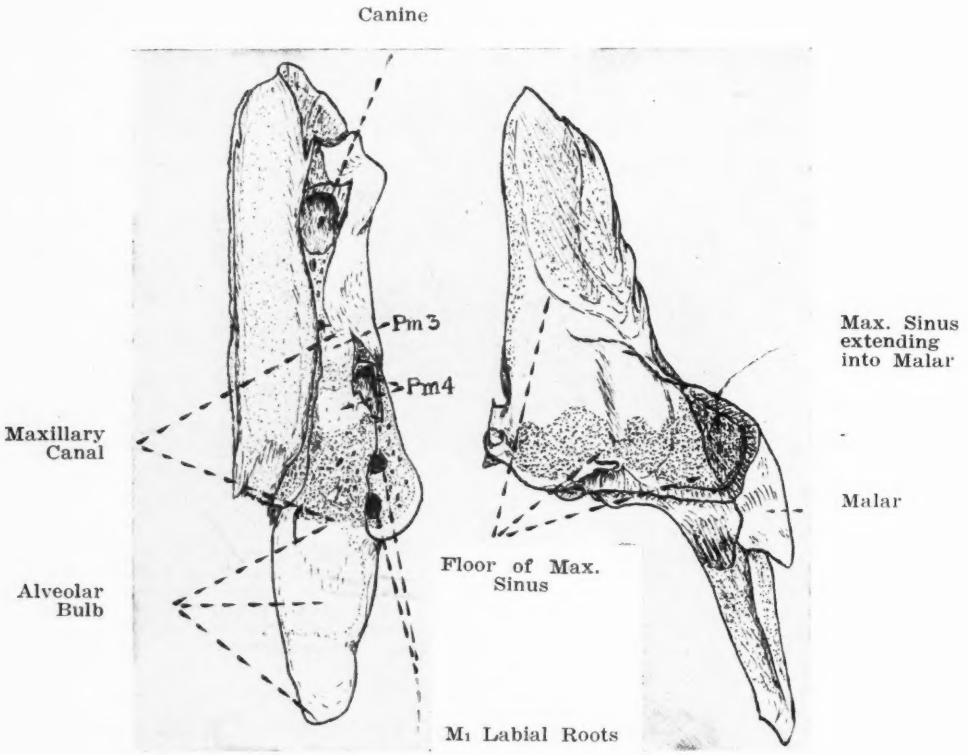


Fig. 6. Fig. 7.

Fig. 6.—Upper surface of the lower half of the right maxilla of a pig, twenty-eight weeks old, divided by a horizontal cut passing through the maxillary canal. The floor of the canal is exposed from the "infraorbital" foramen in front to the alveolar bulb behind. To illustrate the account in the text of the extension downwards of the maxillary canal into the alveolar bone. The stippled areas represent old bone, and the white areas new bone laid down during a period of four weeks. x⅔.

Fig. 7.—The upper surface of the upper half of the maxilla in Fig. 6. To illustrate the backward movement of the maxillary sinus and the extension downwards into the alveolar bone of the lateral part of its floor. The stippled areas represent old bone, and the white areas new bone laid down during a period of four weeks. The new bone in the floor of the sinus is being added on its inner aspect in front but on its outer aspect behind. x⅔.

downward movement of the maxilla as a whole in relation to the other bones of the skull, and that the growing alveolar border is responsible for the real increase in the height of the maxilla—these conclusions are quite in conformity not only with the evidence from sutures in other parts of the skull, but also with what I believe to be the general principle of skull growth—expansion by deposit on free surfaces only.

The whole question will in due course be the subject of another publication; in the meantime the point is that the alveolar border being a part of the free surface of the maxilla, the growth additions to it are responsible to a very great extent, if not solely, for the increase in height of the body of the bone. The agreement with the conclusion already reached for the body of the mandible is obvious, and the two sets of observations, if they stand the test of discussion and of further evidence, throw into prominence the fundamental importance of the activities of the alveolar bone.

We turn for a part of that further evidence to the floor of the maxillary canal, to the plate of bone which separates it from the overlying maxillary sinus, and to the outer part of the floor of the sinus itself. In the period which my specimens cover, the maxillary canal immediately overlies the inner part of the alveolar border from the second deciduous molar backwards, while the outer part of a smaller extent of the same portion of the border lies directly beneath the sinus. We find in the first place that a broad thin sheet of new bone is being laid down on the inner aspect of the anterior part of the floor of the sinus, extending on to its lateral wall, but that the position of the new bone at the back of the sinus is reversed since it is on the outer side of the wall that it is found (Fig. 7).

It is clear from the distribution of the new bone that the sinus as a whole is traveling backwards in conformity with the changes already referred to, which affect the anterior surface and malar process of the maxilla, and with the backward growth of the hinder end of the alveolar border itself. In the middle and outer part of the floor of the sinus, however, active absorption is proceeding, and it is equally clear that, as the sinus is being remodelled in the backward direction, it is also deepening at the expense of the alveolar border.

The floor of the maxillary canal has the same tale to tell (Fig. 6). In the anterior part, according to the age of the animal, there are elevations covered by new bone laid down as the underlying crypts of the premolars expand in this direction; but behind these, and continuing right on to the base of the alveolar bulb, there is again active absorption, so that in the course of three to four weeks the canal has extended right into the new bone which has meanwhile been forming in the lingual alveoli of the underlying molars, as is also the case in some specimens with the floor of the sinus itself and the buccal alveoli of the same teeth.

Here then is confirmatory evidence of the conclusion that the alveolar is the growing edge of the maxilla as of the mandible: in the maxilla also the deduction is to be made that there is no real distinction between alveolar and other bone; as the process which we have outlined proceeds, bone which was formerly on the edge of the alveolar border becomes incorporated in the walls of the maxillary canal and sinus, strengthened by interstitial deposit into compact bone to take its share in the support of the alveolar bone which has succeeded it.

Here I would again refer to the fetal and adult positions of the maxillary nerve in relation to the alveolar bone in the human skull as part of the evidence that the same process exactly is at work in the growth of the human maxilla. The increase in height of the human maxilla, greater in proportion

than in the maxilla of the pig, can only be by the growth of its alveolar border followed by the excavation of the antrum, which in the end widely separates the nerve from the alveolar bone with which in the beginning it was in the closest contact.

As further confirmatory evidence of the conclusions thus briefly outlined, I would also once more call attention to the process, now, I believe, well recognized, by which the hard palate, relative in its position like everything else, descends by addition below and absorption above in conformity with the growth of the alveolar border. The height of the palate and its relation to the floor of the antrum at any given period are but an expression of the relative rates at which the growth of the alveolar border, the excavation of the floor of the antrum and the growth descent of the palate itself have been proceeding.

To sum up this part of the paper it may be said that the growth of the alveolar bone is of the greatest, possibly of sole, importance for the general increase in height of both the mandible and the maxilla. In the pig it is in this respect relatively more important in the mandible than in the maxilla, since the chief growth directions in the face are forwards and backwards to elongate the snout. In the human skull, on the other hand, the relative importance is almost certainly reversed, since here the chief growth direction is downwards. This conception agrees with the observed facts in the human skull of the developing relation of the alveolar bone to the orbit and the extension of the antrum between them.

THE GROWTH OF ALVEOLAR BONE IN RELATION TO MOVEMENTS OF THE TEETH*

Having now reached an important conclusion regarding the constant growth of the alveolar bone, it is with added interest that we turn to the question of what happens to the teeth. If the alveolar bone grows and continues to grow in the manner I have described, the teeth which it contains and supports must necessarily be constantly moving with it, or else the fate of all would be the reverse of what happens to the molars as they emerge from the root of the coronoid in the mandible—they would be reburied in the bone from which in eruption they had previously emerged. Yet for the most part, once and so long as teeth are in position, they appear to undergo very little change in relation to the bone which supports them. Hence the tenaciously held opinions regarding the cause of the similarity of the deciduous and permanent alveolar arches.

To quote Sir Charles Tomes' summing up of Sir John Tomes' original account: "In the region of the jaws occupied by the twenty deciduous teeth very little growth or change subsequently takes place, so that it comes to pass that the incisors, canines and premolars ultimately occupy an arch which hardly differs either in size or shape from that occupied by their predecessors. . . . If, then, in the treatment of irregularities, whether threatened or accomplished, we expect improvement due to growth in this anterior region of the mouth, we shall be disappointed; yet how seldom, if we read

*Sir Arthur Keith was the first to point out the significance of the relation of alveolar bone growth to movements of the teeth, with particular reference to their eruption. *Vide* Ref. No. 4.

the lengthy and involved dissertations which from time to time appear upon this subject, is this fundamental truth fully grasped. It may be thought that this point about the very small growth of that portion of the jaws occupied by the deciduous teeth had been already proved *ad nauseam,* and that anything more was superfluous. But . . ."

But . . . the fundamental truth about the growth of the skull is the difference between appearance and reality. We can believe that the teeth are the same, but that the arches also appear to be the same, even if there were not differences that can be measured, is no proof that they have not altered. Growth in the region occupied by the twenty deciduous teeth there undoubtedly is, though whether it may of itself produce improvement of irregularities or, when its nature is an open book, be guided in so doing, is another question. Relatively is again the watchword, and the movements of the teeth in the alveolar border, to which we now proceed, are but another example of the process which we are learning to regard as universal in the growth of bones—the maintenance or the alteration (by the processes of deposit and absorption) as function demands, of the relative position of different points.

Now there are three possible directions in which the teeth may move in the alveolar bone.

1. In a vertical plane, upwards or downwards in the line of their own long axis.

2. In the horizontal plane at right angles to the plane of the alveolar border, i.e., outwards or inwards in a buccolingual line.

3. In the horizontal plane parallel to the plane of the alveolar border, i.e., forwards or backwards in a proximodistal line.

I may say at once that evidence is now available to demonstrate normal movements of the teeth, both fully erupted and erupting, in all three directions during the growth of the jaws.

MOVEMENTS OF THE TEETH IN THE VERTICAL DIRECTION IN THE GROWING ALVEOLAR BORDER

If there be a continuous uninterrupted growth of the alveolar bone all along its edge, so that, irrespective of temporary local absorptions as teeth erupt, its actual surface is constantly being added to, it follows that there must be a general movement of the teeth upward in the border, if they are to maintain their relation to the surface. This continuous upward movement of the whole row of teeth does in fact take place. The movement, of course, is not all in the same plane, but the actual direction of the movement of any particular tooth depends upon the inclination of the part of the alveolar border in which it happens to be set. In the jaws of the pig, for example, the teeth in the premolar region rise more or less vertically, whereas the incisor and canines move in the oblique direction of the part of the alveolar border in which they are set. The front part of the border in the mandible is very oblique, and growth in that region results in large additions to the length of the mandible; the incisors move forwards a corresponding amount to maintain their level.

Turning to the observed facts of bone growth in relation to this general movement upwards, it may be said that in general new bone is added to the walls of the alveoli and to the interalveolar septa in amount corresponding to the growth of the edge—the amount added in the alveoli being sufficient to narrow the lower part and fill up the apex as the tooth rises into the newly formed upper part. In this way it is clear that the alveolus even of a fully erupted and apparently stationary tooth is constantly altering so that in due time it is entirely new (Fig. 8 and Plates III and IV).

But we must not expect to find on looking into the alveoli in our madder specimens that their inner walls are entirely formed of new bone. The details of the additions to these inner walls vary from tooth to tooth, in the first place according to the obliquity of their implantation in the border, and also in conformity with the different combinations of movements in the other two directions. The effect of oblique implantation upon the distribution of the new

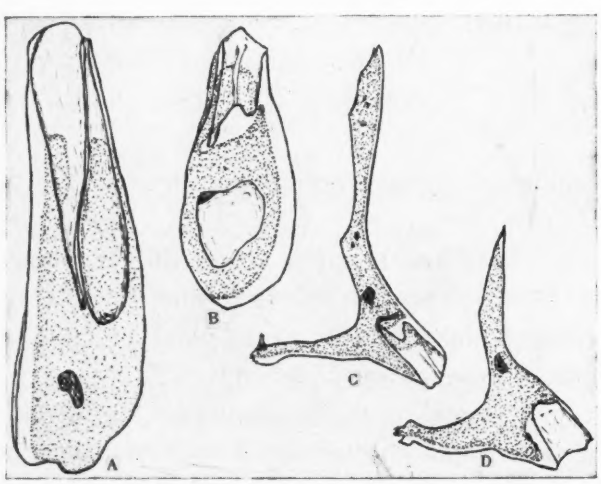


Fig. 8.—To illustrate the distribution of new bone associated with upward movement of the teeth in different situations. Sections of the left mandible and maxilla of a pig twenty weeks old. The stippled areas represent old bone, and the white areas new bone laid down during a period of four weeks. *A*, Alveolus of mandibular central deciduous incisor with crypt of permanent tooth behind; *B*, distal alveolus of mandibular third deciduous molar; *C*, distal alveolus of maxillary second deciduous molar; *D*, distal alveolus of maxillary first deciduous molar. x½.

bone in the alveoli is best illustrated by a simple diagram of the bone changes in the alveoli of a double-rooted tooth which is rising vertically in a growing border (Fig. 9). It is clear that the apex of the interalveolar septum will itself rise vertically, and that new bone will be deposited on both sides of the septum, whereas the anterior and posterior walls of the anterior and posterior alveoli respectively will be the seat of absorption, involving necessarily a small portion of the new bone of their edges even as it is laid down. It is indeed a little difficult to find a pure example of such a distribution of new bone because of the constantly associated movement of the teeth in two other directions; nevertheless such examples are to be found. In this connection I may be allowed to quote a passage from the first of my lectures in the 1924 Dental Board series. Discussing shortly the question of possible movements of the teeth forwards in the alveolar border, I then said "that my madder specimens

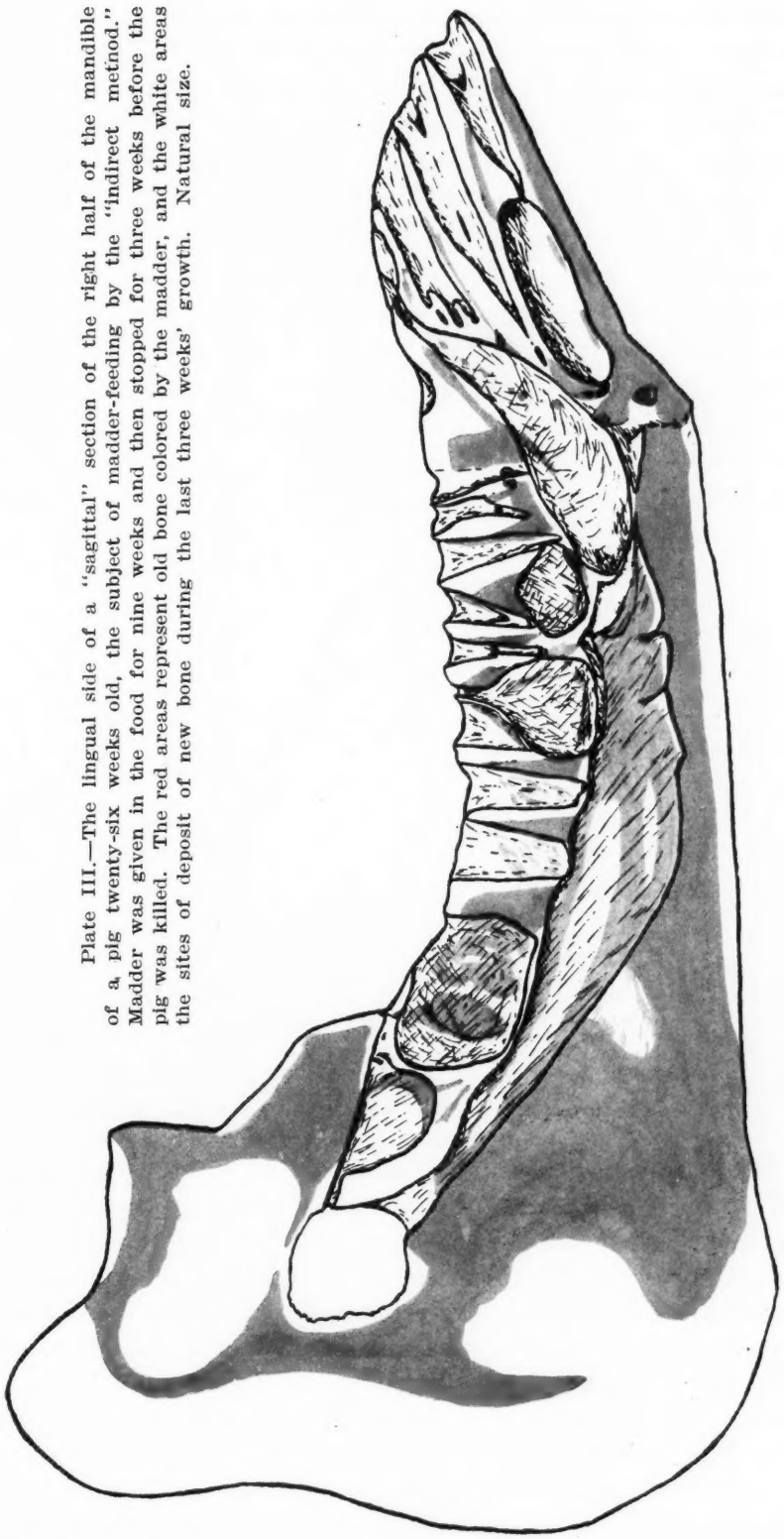


Plate III.—The lingual side of a "sagittal" section of the right half of the mandible of a pig twenty-six weeks old, the subject of madder-feeding by the "indirect metnod." Madder was given in the food for nine weeks and then stopped for three weeks before the pig was killed. The red areas represent old bone colored by the madder, and the white areas the sites of deposit of new bone during the last three weeks' growth. Natural size.

provide no unequivocal evidence of such a movement of the molars in a forward direction in the alveolar border. The general growth of the alveolar border includes, as we have seen, the addition of new bone not only on the free surface, but also on the inner surface of all the tooth sockets; this is associated with the raising of the teeth as the border itself rises. If it were clearly the case that the bone addition to the posterior walls of the sockets is greater than to the anterior walls, this would be evidence of a forward as well as an upward movement of the teeth; no such evidence is forthcoming. In sagittal sections of individual alveoli I have indeed observed a greater amount of new bone on the posterior wall, but in others it is on the anterior wall that the greater amount appears." Fig. 9 is the simple explanation of these observations recorded at the time in diagrams, which I refrained from publishing as I had not grasped their true significance.

Apart from variations in the distribution of new bone on the walls of the alveoli, which find their explanation in the other two movements which

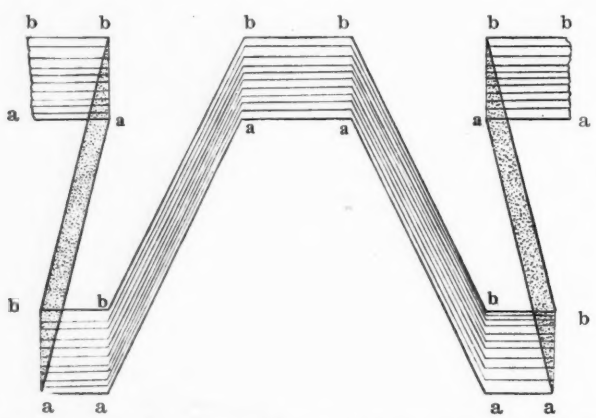


Fig. 9.—Diagram of the sites of bone deposit and absorption associated with the vertical rise of a tooth with double obliquely separated roots. *a-a-a* and *b-b-b*, original and new surfaces of aveolar border and alveoli. The sites of deposit of new bone and the successive positions of the new surfaces are indicated by the series of parallel lines, and the sites of absorption by stippling. It will be noticed that bone deposit and absorption overlap at two places; at the alveolar edge deposit is followed by absorption, at the alveolar apices absorption is followed by deposit. This diagram applies equally well to the changes in the proximal and distal alveoli of a mandibular tooth or the lingual and buccal alveoli of a maxillary tooth.

the teeth constantly undergo, vertical movement then is indicated by the filling of the socket below and its reformation at the surface. In the case of teeth with more than one root, the amount added to the edge of the interalveolar septa corresponds almost exactly to the growth of the edges; whatever the cause of the rise of the teeth, and let us remember that we are speaking now of the upward movement of fully erupted teeth without additions to the length of their roots, the bone growth is found in exact correspondence with it. Since this bone growth is only part of the general growth of the jaw, it is hard to resist the conclusion that we are dealing here, as I said, with another example of maintenance of relative position by bone growth and bone absorption, and that in fact the growth of the alveolar border, with additions to interalveolar septa and the filling of the alveoli from below, is actually responsible for the movement of the teeth.

Plate IV.—The buccal side of the "sagittal" section of the right half of a mandible, natural size. (Same mandible as Plate III.) Attention is particularly directed to the distribution of the new bone in the alveoli as described in the text. The differences between the lingual and buccal sides and the proximal and distal walls in Plates III and IV indicate movements of the teeth in the buccal and proximal directions. The backward growth of the large alveolus of the permanent canine in the mandibular canal is also demonstrated. (The disproportionate size of the incisor regions in Plates III and IV is due to the fact that these regions were drawn separately and fitted on to the rest of the drawings so as to give a complete view of the lingual and buccal sides of all the alveoli with consequent loss of perspective.)

To sum up conclusions with regard to the vertical movement of the teeth, it may be said that during the period of growth the whole row of completely erupted teeth is constantly rising in the growing alveolar border. Movement of this nature in a straight border maintains the teeth in the same relation to each other and apparently in the same relation to the border itself, but in a curved border the circumference must gradually increase and the spaces between the teeth with it. This actually happens to a very considerable extent in the anterior part of the pig's jaws, and it is most probably partly responsible also for the observed separation of the human deciduous teeth.

VERTICAL MOVEMENT OF THE TEETH DURING THEIR ERUPTION

The vertical movements which we have been discussing are those observed in the case of fully erupted teeth; they are movements which, in the absence

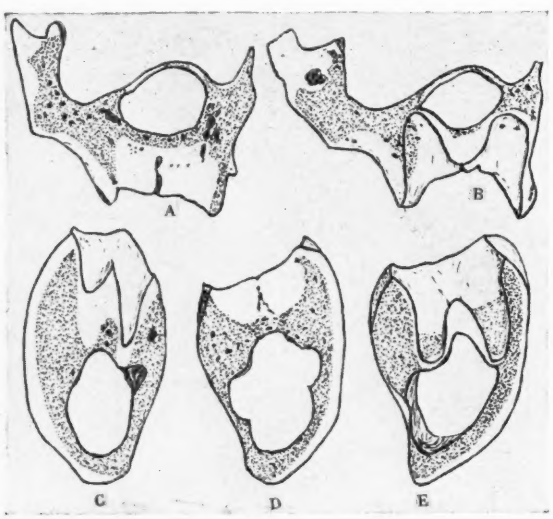


Fig. 10.—Series of sections of maxillary and mandibular alveoli of left first permanent molars to illustrate the deposit of new bone associated with the eruption of that tooth. From a pig twenty weeks old; the stippled areas represent old bone, the white areas new bone laid down during a period of four weeks. *A*, Distal view of section through interalveolar septum of maxillary M_1; *B*, proximal surface of distal alveolus, maxillary M_1; *C*, proximal surface of proximal alveolus, mandibular M_1; *D*, proximal view of section through interalveolar septum of mandibular M_1; *E*, distal surface of distal alveolus, mandibular M_1; in *A* and *B* the relation of the alveoli to the overlying maxillary canal and sinus is shown. Cf. Fig. 2. x½.

of knowledge of the constant growth of the alveolar border, may completely escape our notice. Having satisfied ourselves in the light of that knowledge that these constant vertical movements of fully erupted teeth do in fact take place, the next question that at once presents itself for consideration is the relation of the hidden movement of erupted teeth to the manifest movement of erupting.

I am not yet in a position to give a completely detailed account of the relation of bone growth to all stages of the eruption of all the teeth in the pig, but if we consider the eruption of the third permanent incisor and the first permanent molar, which are most fully represented in the period which my specimens cover, we are provided with examples of the eruption of teeth, single and multirooted, with and without deciduous predecessors.

Now if we examine madder specimens of all stages in the eruption of the first permanent molar, we observe in the first place that the bone growth in a vertical direction, which from the nature of the case we know must be taking place, is in its general distribution similar to the bone growth which is simultaneously raising the fully erupted fourth deciduous molar in front of it (Plates III and IV and Fig. 10). The bone growth is the same although the roots of the former are growing throughout the period, whereas the roots of the latter have already attained, or attain during the period, their maximum length, or in the later stages may be undergoing absorption in relation to the underlying sac of its permanent successor. After the preliminary absorption of the alveolar edge to allow the passage of the tooth, there are additions to the edge itself, to the interalveolar septa and on the walls of the individual alveoli, all similar to those I have described for the fully erupted tooth, only in greater amount. While the amount of the new bone is always greater in the vertical direction, it will, however, be readily understood that each alveolus has its own individual variations in its distribution, corresponding to the other movements which take place during eruption, including movements of rotation which the molars undergo. At the same time there is addition to the length of the roots of the tooth, an elongation which is not only obvious from their increasing length, but which can also be exactly measured since dentine shares with bone the madder staining.

Now the arguments against root elongation as a "cause" of eruption are familiar to every dental student, and it has long been known that the distance travelled by the crown of an erupting tooth may be considerably greater than the increase in the length of its roots during the same time. But the exact relation of the growing root to the bottom of the alveolus has never been determined, and could not be determined so long as the growth direction of the bottom of the alveolus and the extent of the movement of the tooth itself relative to the moving surface of the alveolar border were unknown. The madder method enables us to make this comparison, and I therefore give here data from the same three pigs as before to demonstrate this relation at different stages of the eruption of the first permanent molar.

TABLE IV

THE RELATION OF INCREMENTS OF MOLAR ROOTS AND ALVEOLAR GROWTH DURING THE SAME PERIOD

PIG NO.	ROOT GROWTH LEFT FIRST MOLARS		ALVEOLAR GROWTH INTERALVEOLAR SEPTUM	
	LOWER	UPPER	LOWER	UPPER
15	1.5	1.7	1.9	Slight
12	4.6	4.1	4.9	4.4
2	1.6	1.3	0.8	0.8

ORTHODONTIC TREATMENT WITH ARMS, SPRING LOOPS, FINGERS, JACKSON EQUALIZING POSTS, EITHER SPRING OR RIGID, AND INCLUDING THE MOVEMENT OF THE TEETH BODILY AND RETAINING THEM*

By V. H. Jackson, D.D.S., New York City

DR. V. H. JACKSON presents the following report of his clinic. He presented 88 models and 39 appliances.

Of these models, the models of individual special cases were grouped separately. To distinguish them, they were supported on holders of different colors. The successive models of each case were arranged on the holder in the order of the progressive changes from the force effective by the appliance shown with them.

The plan of all appliances utilized in the Jackson system of orthodontia requires only three distinct forms of base wire as a foundation, the wire being of rather large gauge. The base wires are named as follows:

1. A Lingual base wire for the general expansion of the mandibular arch. The base wire has a body with arms. The body is shaped in a curve following the lingual surface of the arch below the gum line and extends backward as far as the posterior surface of the last erupted molar on each side of the arch where the base wire is bent on itself in a sizable curve to extend forward forming arms to cross the surface of the molars and the lingual side of the teeth, to engage with the cuspids. Partial clasps are usually arranged on each of the teeth to which these arms are finally soldered.

2. A Palatal base wire for the anterior lateral expansion of the maxillary arch is arranged to cross the palatal arch from side to side following the palatine curve with the ends bent to extend forward crossing the molar and premolars to engage with the lingual side of the canine.

3. A Palatal base wire with loop for the general expansion of the maxillary arch. The body of the palatal base wire with loop is shaped to rest deep in the palatine vault with the arms shaped to extend forward to rest on the lingual side of the molars, premolars, and canines. The palatal base wire with loop is made similar to the palatal base wire, the loop resting deep in the palatine vault. The arms are shaped to rest on the partial clasps fitted to the molars, premolars and canines to which they are finally soldered.

To the arms are attached, when desired, fingers of spring wire in any form, as straight or curved fingers, with corrugated or U-shaped loops, for causing pressure in pushing or pulling, in moving any of the teeth that require further adjustment.

*Clinic presented before the Twenty-sixth Annual Meeting of The American Society of Orthodontists, Chicago, May 2-5, 1927.

Group 1.—Important movements of the teeth were shown by the several different groups of models. The most important group, No. 1, was that of a boy of four years and seven months, having an unusually deep palatine vault for his age, accompanied with nasal stenosis.

In these cases with *narrow arch* and *deep palatine vault,* early treatment is always advised. Treatment should always be taken up early as the added development from the edges of the palatine bones causes them to encroach on the nasal space, often effecting chronic stenosis.

The roof of the mouth is the floor of the nose and for treatment in this case as in all cases, the arches were expanded laterally for the purpose of preventing the palatal processes through their added development from continuing to encroach detrimentally into the nasal space, the great cause of nasal stenosis, and the early free lateral expansion of the dental arches not only improves the nasal space but prevents the palatal processes from developing upward, as described, and encroaching on the nasal space. This condition is reduced by the *early* extensive broadening of the arch to a *width* sufficient to take up the developing measurement of the palatal processes. This treatment should always take place before these palatal bones become dense.

As shown by measurement of the depth of the vault in Model No. 1 of the group, when the child was four years and seven months of age, it measures fifteen millimeters, and in Model No. 5, when the patient was seventeen years of age, the measurement indicates fifteen millimeters, not deeper than when the child was four years and seven months of age.

Group 2.—A similar case of abnormally narrow arches of a child, four years of age, was illustrated by six models in a group on a holder. In this case, as in others, the gradual expansion of the arches increased the nasal capacity, and at the same time the added space provided between the lateral maxillary divisions of the arches was made sufficient for the accommodation of the four permanent incisors, or woman's incisors, at this early age, which in this case the central incisors erupted one or two years earlier than is considered normal for the eruption of these permanent incisors.

Group 3.—In the third group of nine models on a holder, was shown a case of extreme bodily movement of a mandibular left labially impacted canine, located at the junction of the left mandibular central and lateral incisors, with no space in the arch for its accommodation. The successive models illustrate the progressive expansion of the dental arch to provide room for the canine. At the same time, a finger extending from the appliance to the labial side of the arch, Model No. 3, was bent into a U-shaped loop with the end of the spring flattened to move the canine labially from the incisors enough to cement a collar with a perpendicular tube to it.

For moving the tooth bodily, the end of the looped spring was shaped to enter the tube from above downward, as shown by Model No. 4, and adjusted for applying force for moving the apex and body of the tooth as desired.

Force for moving the canine bodily was caused by closing the loop of the spring a little about twice each week. See Models 4, 5, 6, 7. The latter model shows the canine in normal position and in good occlusion.

The x-ray does not show congestion about the root.

Treatment extended from March, 1926, to March, 1927, as shown by the models.

Group 4.—Fourth group of five models on a support, illustrating a case of girl, age twelve, having extreme posterior occlusion of the mandible and protrusion of the maxillary arch. The models illustrate the different stages and completed treatment, through the equalizing and lateral expansion of the dental arches, bringing about a normal occlusion.

Group 5.—Fifth group of six models on a support illustrating case of boy, age fourteen years, having very extreme posterior occlusion of the mandible and protrusion of the maxillary arch with the lower incisors antagonizing with the gum far back of the upper incisors. Models illustrate the different stages of treatment and appliance showing plan of contracting incline bite plane in use with rubber equalizing bands for changing the angle of the mandible in bringing about a normal occlusion.

A box with two models attached, arranged in a manner to respond to force, known as an "equalizing box" was used in demonstrating the use of equalizing bands for equalizing the dental arches.

Group 6.—Sixth group of three models illustrating the "Jackson Equalizing Posts," which he devised and has used both rigid and spring posts in certain cases for many years for retaining, sustaining and correcting cases of posterior occlusion of the dental arches. For these purposes the rigid posts are usually employed. Spring posts are an advantage in some cases, especially in the movement of the teeth, and occasionally in the adjustment of the relationship of the dental arches.

The equalizing posts are important in cases as described in groups four and five.

The posts are attached to the posterior portion of the regulating apparatus projecting downward to engage with a flange on the lingual posterior part of the mandibular regulating appliance used. These posts, one on either side, are sufficiently long to remain engaged with the flanges of the mandibular appliance when the patient is in the act of opening the mouth for any ordinary purpose and do not interfere with mastication.

The equalizing posts are used for immediate adjustment and sustaining normal relationship of the arches, in treatment of cases having unilateral prognathism.

A single post was utilized with comfort in correcting a case of unilateral prognathism for a man thirty-five years of age, a university professor. For this purpose the location of the post is usually attached to the maxillary appliance projecting downward on the lingual side of the arch and opposite the first molar. The post is long enough to rest on the lingual surface of the appliance in the lower arch, and not become disengaged during mastication or ordinary movement of the mandible. In these cases the post needs to be worn some little time.

It is usually not quite so practical for the post to be attached to the lower appliance and project upward, although it is sometimes used in that manner.

Group 7.—Group 7, four models on a holder before and after treatment of case with contracted arches, the lower arch having only room for three incisors between the canines, the fourth incisor having lingual occlusion. The special feature of this mandibular appliance was the arrangement of the fingers attached to the arms of the expanding appliance. In expanding the arch, the finger from one arm was shaped to move the three incisors with the maxillary division and the finger from the other arm of the appliance grasped the lateral incisor that was in lingual occlusion, and force was applied by the arms of the appliance for the required lateral expansion of the arch, at the same time moving the incisors so that when there was sufficient expansion between the canines for the four incisors, they were easily completely arranged in normal position. This plan much simplified the ordinary methods.

Group 8.—Group 8 supports eight models, showing the effectiveness of treatment for a brother and sister who had narrow arches with deep palatine vault like their mother. Four models illustrate the treatment of the very contracted arches of the son, age fourteen, showing the expanded arches, much improved occlusion and nasal space. The other four models illustrate the treatment of the contracted arches of his sister, age 10 years, showing the extensive expansion of the arches, much improved occlusion and nasal space. These sets of models demonstrate the particular advantage of the more early treatment, which invariably yields the better result, especially of the palatine structures, this being shown particularly by the improved condition for the daughter, who was several years younger.

Group 9.—Group 9, four models on a support. Boy age fourteen. Models illustrate the full lingual impaction of the maxillary and mandibular second premolar, and treatment. Extraction of these impacted teeth should seldom be permitted. They as all of the other teeth, will be needed when the boy becomes a man. As shown with appliance in place, spaces are provided for the impacted teeth, at the same time the arches being expanded laterally.

Group 10.—Twelve appliances and models. On three similar holders were mounted 12 models, each model with an appliance designed for an individual purpose in addition to the expansion of the arch. Most cases of teeth in malposition require expansion or added space for their correction. Some of these appliances were anchored with what are known as wire clasps extending from the lingual arm of the appliance to the buccal side of the tooth to rest near the gum for anchorage. Others were anchored with the "Locking Device," that is, a collar with a buccal or lingual lug cemented to the anchorage tooth and a wire clasp arranged to extend from the lingual arm of the appliance to hook over the buccal lug on the collar. The end of the wire clasp always terminates in a hook which is immediately useful for the attachment of a rubber "equalizing band" when needed.

The purposes of the appliances shown were for expansion, for moving the teeth in any required direction, rotating, elevating or depressing teeth with their sockets, providing space for impacted teeth.

In this exhibit was described a distinct plan of diagnosis for the child and diagnosis for the controlling treatment for the adult, the plan being applied for treatment for an adult of any age.

In the collection of models of cases treated, treatment was described for patients ranging from four years to twenty-six years of age.

As there are a considerable number of models presented, the author is not requesting that any of them be illustrated at this time.

ON IDENTICAL TWINS*

By Frederick Lester Stanton, D.D.S.

Professor of Preventive Dentistry, New York University, College of Dentistry

AT THE recent International Orthodontic Congress, Dr. J. A. Detlefsen of Philadelphia presented a paper on "Developmental Limitations Imposed by Hereditary Factors" and illustrated the paper with photographs of dental models. Thirty-five cases of identical twins were shown—there was a remarkable similarity shown by photographing each pair of casts together.

Professor Mitsuru Okada of Tokyo had completed a more elaborate study at my office of a pair of identical twins, whom we had under orthodontic treatment.

As a result of Professor's Okada's painstaking work on these twins, it is hoped that a more general interest will be shown by orthodontists towards precision instruments and engineering formulae in relating maps for comparison.

In relating arch forms for comparison, it is suggested that orthodontists should adopt a standard technic. Until a better way is suggested, the following formula is offered:

The occlusal plane shall be the plane of projection. In previous papers the occlusal plane has been reduced to an engineering formula. An axis of symmetry and denture centroid shall be determined as outlined in previous papers. Map relations (for comparison) shall be controlled in three dimensions by the centroid and axis of symmetry.

The Frankfort Plane shall not be used as the plane of projection for the dental apparatus. All planes of the head, Frankfort Plane or other anthropologic planes, may be easily shown on three elevations controlled by the occlusal plane and the denture centroid as the point of origin.

India ink drawings made by Dr. Otto Sorensen and Dr. Charles Mason.

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*Read before the New York Society of Orthodontists, October 27, 1926.

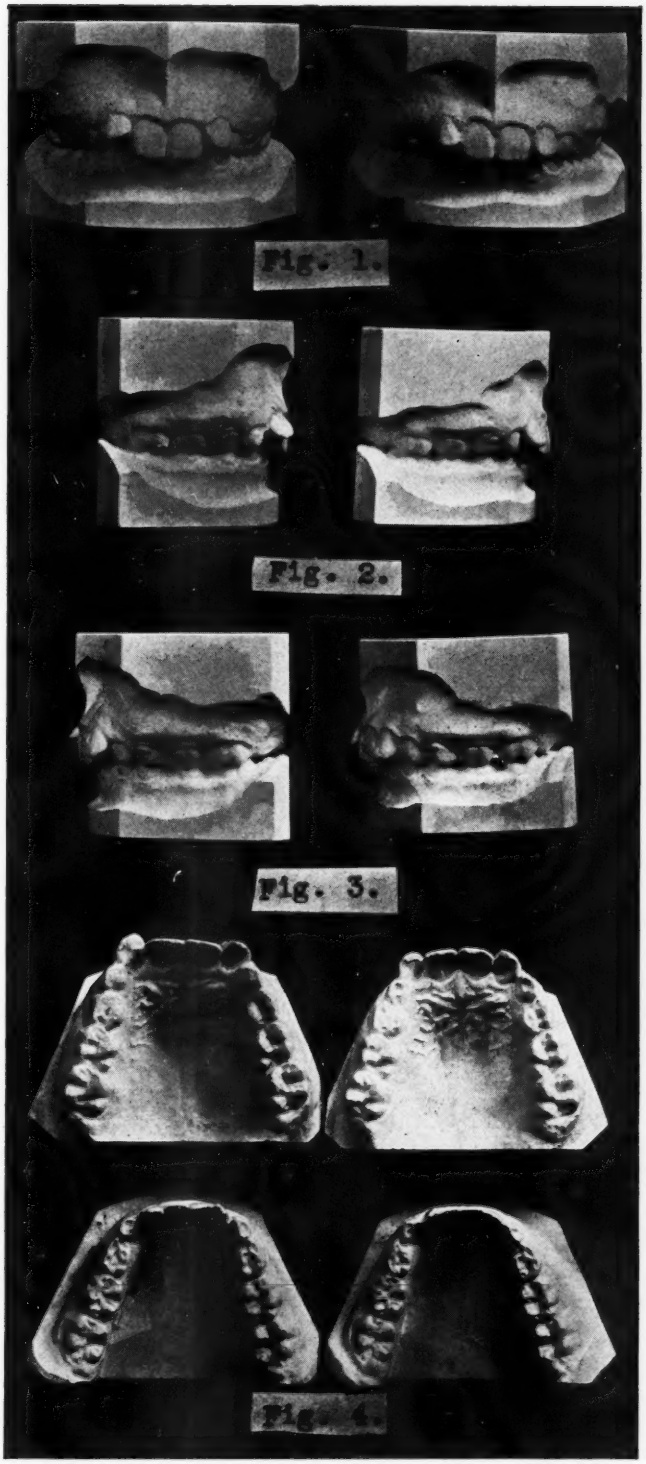


Fig. 1.—Front View of Models. Left A. M. Right E. M. Age 10 years, 3 months.
Fig. 2.—Right side view of models. Left A. M. Right E. M.
Fig. 3.—Left side view of models. Left A. M. Right E. M.
Fig. 4.—Occlusal view of models. Left A. M. Right E. M.

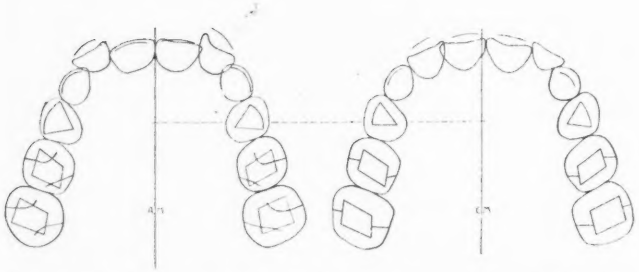


Fig. 5.—Orthographic projection of upper models. Left A. M. Right E. M. Maps related by means of axis of symmetry and denture centroids (centroids connected by dotted line).

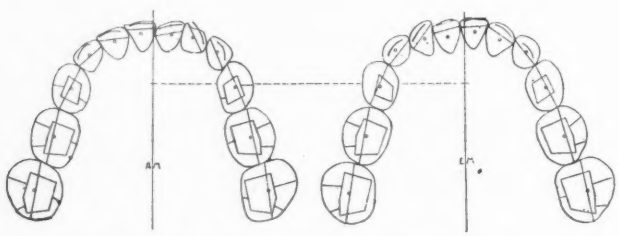


Fig. 6.—Maps of the lower models. Controls like Fig. 5.

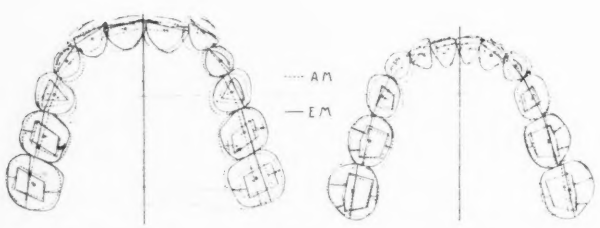


Fig. 7.—Malocclusion maps superimposed. Left upper maps, A. M.—E. M. Right lower maps, A. M.—E. M.

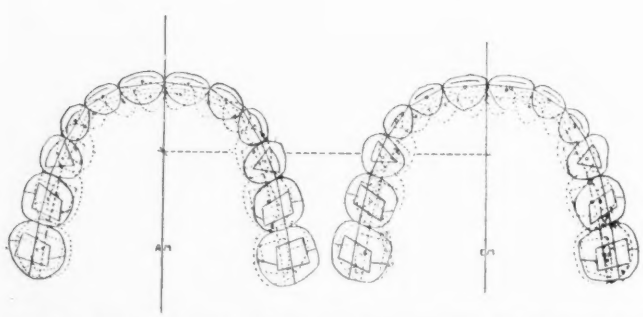


Fig. 8.—Predetermined occlusion maps. Left A. M. (Upper solid line) (Lower dotted line) Right E. M. (Upper solid line) (Lower dotted line).

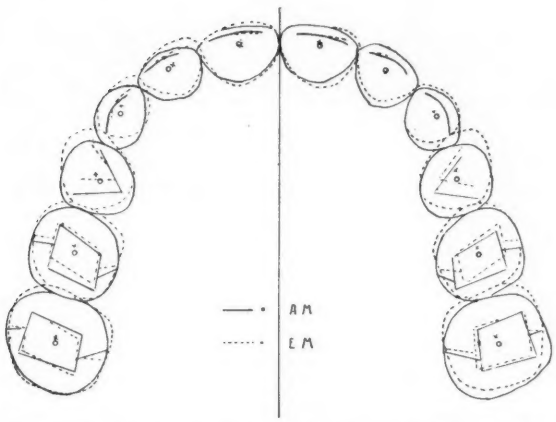


Fig. 9.—Two upper predetermined occlusion maps superimposed. Solid line A. M. Dotted line E. M.

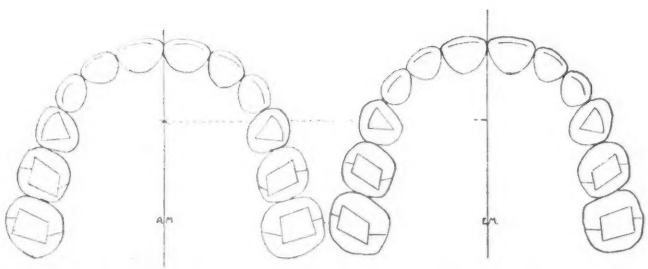


Fig. 10.—Two upper predetermined occlusion maps contrasted. Left A. M. Right E. M.

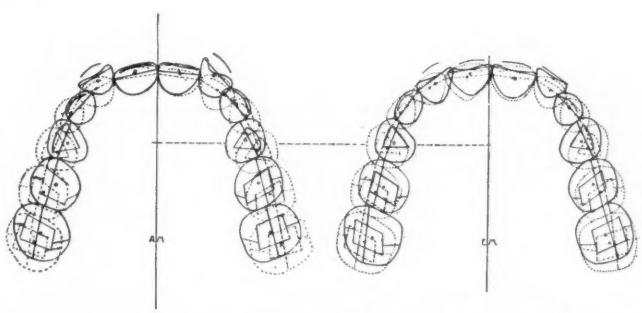


Fig. 11.—Maps of malocclusion (upper) related to maps of occlusion to show the minimum movement to change from one configuration to the other, i.e., the sum of the squares of movement is a minimum. Left A. M. Right E. M.

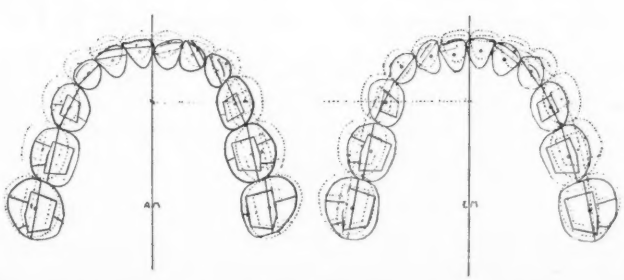


Fig. 12.—Maps of malocclusion (lower) related to maps of occlusion. Left A. M. Right E. M.

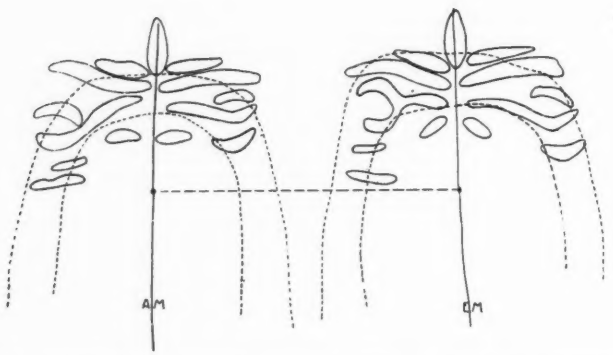


Fig. 13.—Rugae contrasted. Dotted contour lines of palate. Dotted at 5 mm. levels above the deepest point of the palate. Deepest point shown as round dot on the median suture. Maps related by means of the deepest palate points (connected by dotted cross line).

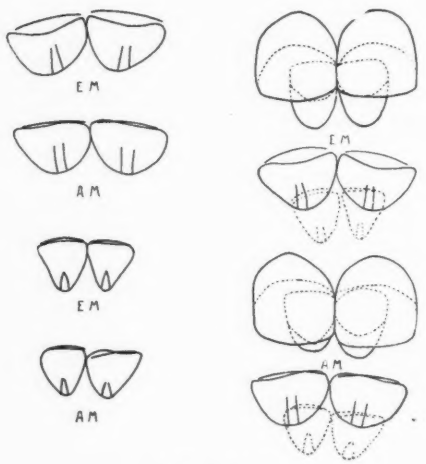


Fig. 14.

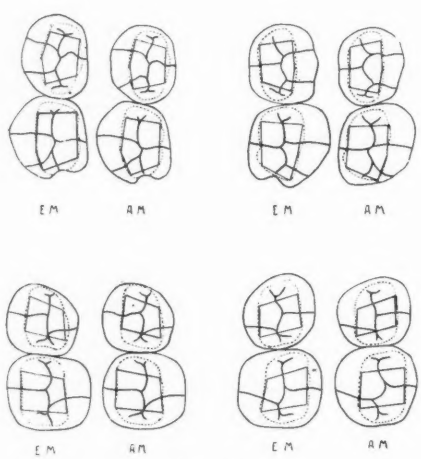


Fig. 15.

Fig. 14.—Left row. Horizontal projections of upper and lower incisors. (Inclination shown by position of incisal edge in the projection.) Right row. Top figure vertical overbite dotted lines lingual gum lines. Second figure horizontal overbite. Third figure vertical overbite A. M. Bottom figure horizontal overbite A. M.

Fig. 15.—Horizontal projections of first molars and two temporary molars showing similarity of tooth sizes and patterns.

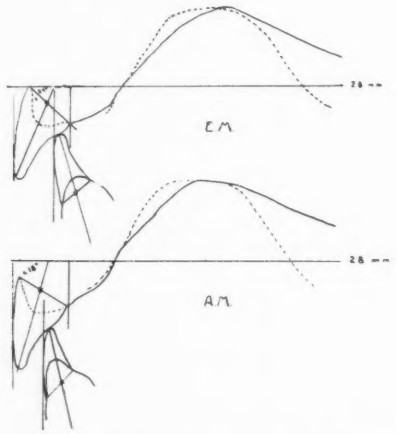


Fig. 16.—Sagittal section through incisors and palate. Dotted lines cross-section of palate. Maps related by means of denture centroid.

A REVIEW OF RECENT LITERATURE PERTAINING TO RICKETS*

By Samuel Adams Cohen, M.D., New York City

THE influence of unbalanced diet and lack of sunshine in the production of rickets is now generally accepted. It is notably present in the populous and crowded industrial cities.

An investigation of the works of artists at the end of the fifteenth century reveals pictures of clinical rickets—square heads, pot bellies, Harrisons's groove, and even deformities of the leg bones. Rickets undoubtedly existed to some extent at all times and periods of the world's history.

There is now no reason, in view of what is known of its causes, to say that rickets is, or must be, a disease exclusivley of even remotely modern times, or that it is a disease called into existence by the peculiar condition of life in modern civilized communities.

Rickets.—A brief summary with reflections. Henry J. Geastenberger, Jour. Am. Med. Assn., July 23, 1927, lxxxix, 4.

The term rickets was at first applied to the clinical picture arising from the changes in the gross architecture and form of the bone. Under the microscope it was later found that rickets showed a lack of calcification and the increase of osteoid tissue. Later rickets was accepted to be basically a disturbance of the calcium and phosphorus metabolism.

Many of the older clinicians have maintained that rickets is a general metabolic disease which affects the body as a whole, but which shows the clinically recognizable results of its activity principally in the osseous system which is growing most rapidly at the given time.

Some authorities hold that the primary stage in the pathogenesis of rickets is a general metabolic disorder, acidotic in type. Some hold to the fact that rickets fundamentally is a growth disorder. Howland maintains in contradistinction to Findaly that it is the abnormal phosphorus metabolism rather than abnormal calcium metabolism which is important in the pathogenesis of rickets, and concluded that the deficit developed over the route of inadequate absorption from the intestinal gland.

Such factors as heredity, lack of exercise, cow's milk and human milk containing diets and vitamins all play merely secondary rôles to the primary and fundamental causes of rickets, namely, inadequate exposure to the acinic rays or their equivalent of growing human infants.

The amount of exposure or the amount of antiricket factor in the form of cod-liver oil necessary to prevent rickets according to studies of the author and coworkers made on premature infants seems to bear a direct relation to the rate of growth. In order to prevent rickets the administration of cod-

*Read at the Thirty-ninth Annual Meeting American Pediatric Society, Washington, D. C., May 12, 1927.

liver oil or exposure of the child to the active rays should be begun not later than the second week of life. The data for this statement, which the author will publish later, will offer adequate evidence to combat the idea that recently has begun to grow, that cod-liver oil is not as potent as it has heretofore been thought to be in the prevention of rickets.

The Chemistry Findings in Rickets.—James L. Gamble, Boston Med. and Surg. Jour., September 8, 1927, cxcvii, 10.

In rickets the presenting lesion is obviously a chemical one, viz., the failure of deposition of lime salts in the growing ground substance of bone. We have only theory based on in vitro studies of the behavior in solution of substance concerned.

There is usually little or no lowering of plasma calcium in ordinary rickets. On the other hand inorganic phosphorus in the blood plasma in ordinary rickets is greatly reduced. Tetany is often described as low calcium rickets, and ordinary rickets as the low phosphorus form of the disease.

The result of studies in experimental rickets informs us that lack of a certain unidentified food substance and of sunlight are the chief causative factors in rickets.

Gamble points out that from the practical point of view the important result of the recent studies of rickets is the rediscovering of the curative action of cod-liver oil and sunlight.

Inorganic Blood Phosphate.—Studies of Rats in Rachitic and Nonrachitic Diets. Elizabeth M. Koch, Ph.D., and Meyer H. Cahan, M.S., Am. Jour. Dis. Child., August, 1927, xxxiv, 2.

The authors state that the results of this study indicate that while cod-liver oil raises the blood phosphate to approximately normal, and direct irradiation of the animal and feeding of irradiated cholesterol have some influence in raising blood phosphate, it is still possible, however, to obtain a low phosphate value and a low product of phosphorus multiplied by calcium in an animal which, as far as roentgenogram and histologic examination can demonstrate, shows a perfect calcification of bones.

Rickets and the Morphologic Blood Picture.—Eugene Strausby and Alexander Wittenberg, Ztschr. f. Kinder., 1927, xli, 585.

The authors feel that the relation between rickets and anemia is due to the hypofunction of the bone marrow. The improvement in the blood findings follows when specific antirachitic treatment is instituted.

The Bone Changes Occurring in Renal and Celiac Infantilism and Their Relation to Rickets.—Leonard G. Parsons, Brit. Jour. Dis. Child., August, 1927, ii, 10.

Celiac infantilism may be defined as the arrest of development and stunting of growth which occur in that form of severe chronic intestinal indigestion which is characterized by a high grade of defective fat absorption and carbohydrate intolerance. In the author's opinion bone changes are of frequent occurrence of severe cases of celiac disease. Bone deformities do not occur unless the disease is severe in type and of long standing, and when the child has passed the age of seven years. In a case of moderate severity the

x-ray appearances are very striking. In addition to the delay in the centers of ossification noted by Still, the whole bone is atrophic, fragile and osteoporotic. The cortex is thin and the trabecular meshwork more open and delicate than usual.

The blood chemistry has been investigated in five severe cases of celiac infantilism, and in four cases the blood calcium was low before light treatment was started, but rose under treatment, and in these cases there was also at some period a low blood phosphorus.

The cause of celiac rickets is to be found in the defective fat absorption with resultant defective absorption of vitamin D, calcium and phosphorus.

The Relation of Craniotabes in Premature Infants to Rickets.—Warren R. Sisson and Robert N. Ganz. Read at the Thirty-Ninth Annual Meeting of the Pediatric Society, May 12, 1927, Washington, D. C.

As a result of studies both by roentgenogram and chemical analysis of the blood of 26 premature infants who showed advanced craniotabes, these investigators feel that the condition is usually not associated with rickets, and suggest that the condition is due to an insufficient calcium intake during a period of rapid growth.

The Prevention and Treatment of Rickets.—Edwin T. Wyman, Boston, Med. and Surg. Journ., September 8, 1927, cxcvii, 10.

Wyman in describing rickets states that Howland and Park proved by means of x-rays that the administration of cod-liver oil to rachitic children was followed by the deposition of lime salts in the cartilage and bones after a period of fifteen to twenty-one days.

He also states that it is seldom necessary to use artificially produced ultraviolet rays for the prevention of rickets except in premature babies, as rickets can be prevented in the majority of cases by cod-liver oil and sunshine. In severe active rickets ultraviolet irradiation in combination with cod-liver oil probably hastens the healing processes more than either ultraviolet rays or cod-liver oil alone.

Antirachitic Activity of Irradiated Cholesterol, Ergosterol, and Allied Substances.—Alfred F. Hess, Jour. Am. Med. Assn., July 30, 1927, lxxix, 5.

The antirachitic action of the various irradiated foods and chemical substances was established in the laboratory and in the clinic. Dried milk could be rendered antirachitic by these means, and found effective by some authorities on animals and infants.

Cholesterol could be activated readily by mercury vapor lamp, and opinions are unanimous as to the antirachitic efficiency of irradiated cholesterol.

The brain contains more cholesterol than any other organ in the body. During the past winter, irradiated brain has been fed to a number of infants who were suffering from rickets, and it was found that curative processes rapidly ensued when one gram daily of this preparation was given.

Hess found that activated ergosterol is about 500 times as potent as irradiated cholesterol. He has made use of irradiated yeast from which the

ergosterol was extracted and found this irradiated yeast highly effective as an antirachitic in animals and infants.

The Antirachitic Effect of Skylight.—F. F. Tisdall. Read at 39th Annual Meeting American Pediatric Society, May 12, 1927, Washington, D. C.

F. F. Tisdall concludes as a result of experiments on rats that the skylight, which is the reflected light from the sun, produces an antirachitic effect roughly from one-half to two-thirds of that produced by the available sunlight, which includes the reflected light from the sky.

The practical application of this work is that infants may be placed outdoors, but protected from the direct sun, and still receive a great antirachitic effect from the reflected ultraviolet rays of the sun.

A Plea for Sanity in the Use of the Modern Methods for the Prevention and Treatment of Rickets.—John Lovett Morse, Boston Med. and Surg. Jour., September 8, 1927, cxcvii, 10.

Dr. Morse, Professor Emeritus of Pediatrics, Harvard Medical School states that rickets is no more common now than it was thirty years ago. Nevertheless, much more is being made of rickets at present than in the past.

The ultraviolet rays, whether in sunlight or produced artificially, cause a chemical change in the cholesterol of the skin. This "activated" cholesterol in some way influences the metabolism of calcium, and causes it to be laid down in the bones. Although they are of relatively low intensity, and constitute but 1 per cent of the total solar radiation, there is ample evidence that there are enough active rays to prevent and cure real rickets in this part of the world (Boston) in summer. Ordinary glass keeps out all those rays which are active in rickets. Sunlight transmitted through ordinary glass windows has, therefore, no antirachitic action.

In the summer there are very few active rays in sunlight before 10 A.M. and after 2 P.M. There are fewer short rays in the winter than in the summer. Furthermore, smoke, gases and dust absorb these rays. There is much more smoke in the air, and in consequence, gases, in the winter than in the summer, and when there is no sun there is as much or more dust. Moisture in the air absorbs these rays. In consequence, they are further limited in damp and melting weather. Reasoning on the basis of these facts, it seems improbable that there are enough active rays in sunlight in the winter to either prevent or cure rickets, even if the baby is directly exposed to them.

There is no doubt that the carbon arc and quartz mercury arc lamps are efficient producers of ultraviolet radiation, which will not only cure rickets but prevent its development. It is possible that the exposure of babies to an unusual amount of ultraviolet irradiation over a long period of time may cause an excessive deposition of calcium in the bones, and interfere with or prevent normal growth of the bones in length.

A CLEFT PALATE CASE*

By H. C. Highton, L.D.S., London, England

I THINK perhaps I ought to apologize for bringing before you this evening a communication which is not strictly an orthodontic case, but as it is connected with development I thought it might be of interest. A cleft palate is due to an arrest of development and may involve the hard and soft palate. The consequences of cleft palate in infancy are that suction and deglutition are seriously interfered with. The infant as a rule is unable to take the breast in an erect or semirecumbent posture and must be fed with the mother's milk by a spoon passed well to the back of the mouth, or by a feeding-bottle with a large teat to act as a plug to the cleft. The operation for the cure of the deformity, I understand, is better not done in infancy, as some advise, since bleeding is then badly borne and the cleft, at least of the bony palate, diminishes in width during the first two or three years of life. Infants, moreover, are liable to catarrh of the pharynx and lungs, and coughing and sneezing tends to tear the parts asunder.

The case I wish to bring before you this evening is that of a firstborn child, which I believe is the common type, and in this particular case the cleft involved the soft palate only.

The child was born November 12, 1924, and weighed ten and three-fourths pounds at birth, and the history from birth until the first attendance at the clinic was that the child had had a slight tonsillitis and refused to take anything but the breast; the child suffered from nervous unrest, and the discipline had gone to pieces. The mother attended the clinic with the child for the first time on December 16, 1924. The child was said to have lost three pounds ten and one-half ounces since birth and was obviously very wasted. The cleft palate was only discovered by the mother three days before attending the clinic. The suction had always been poor and the breast milk had been squeezed into the baby's mouth. No other method of feeding had been used. The case was referred to the ward for reestablishment of breast feeding. On December 18 the child was taking ⅜ ounce of milk in twenty minutes. The average amount of breast milk was 1½ ounces, the breast feed being supplemented to 3 ounces with expressed milk, and cow's milk and water, given with a spoon; the mother having breast massage and hot and cold sponging. At the end of December, 1924, an impression was taken, a guess being made at the size of the tray required, a small amount of impression material being used and the excess squeezed into the cleft with the finger. A special tray was then made from the model obtained. Another impression was then taken with the special tray and a vulcanite case made with an obturator extension into the cleft and the case inserted on January 5, 1925.

On January 6 the obturator was used for the first time during the feeds, and the child took 1¼ ounces of milk in twenty minutes. The average amount

*Transactions of British Society for the Study of Orthodontics.

of breast milk was 3¼ ounces, the breast feeds still being supplemented with cow's milk and water. On January 14 the child was taking 2¼ ounces in thirty minutes; the average amount of breast milk was 4½ ounces. The supply of breast milk was now sufficient without giving cow's milk. January 22, 4¼ ounces was being taken in thirty minutes; the average amount of breast milk was 5¾ ounces. The child was still needing a small spoon feed to make feed up to 4½ ounces, the extra amount of breast milk being given to help feed another ward baby. On January 28 3⅜ ounces being taken in

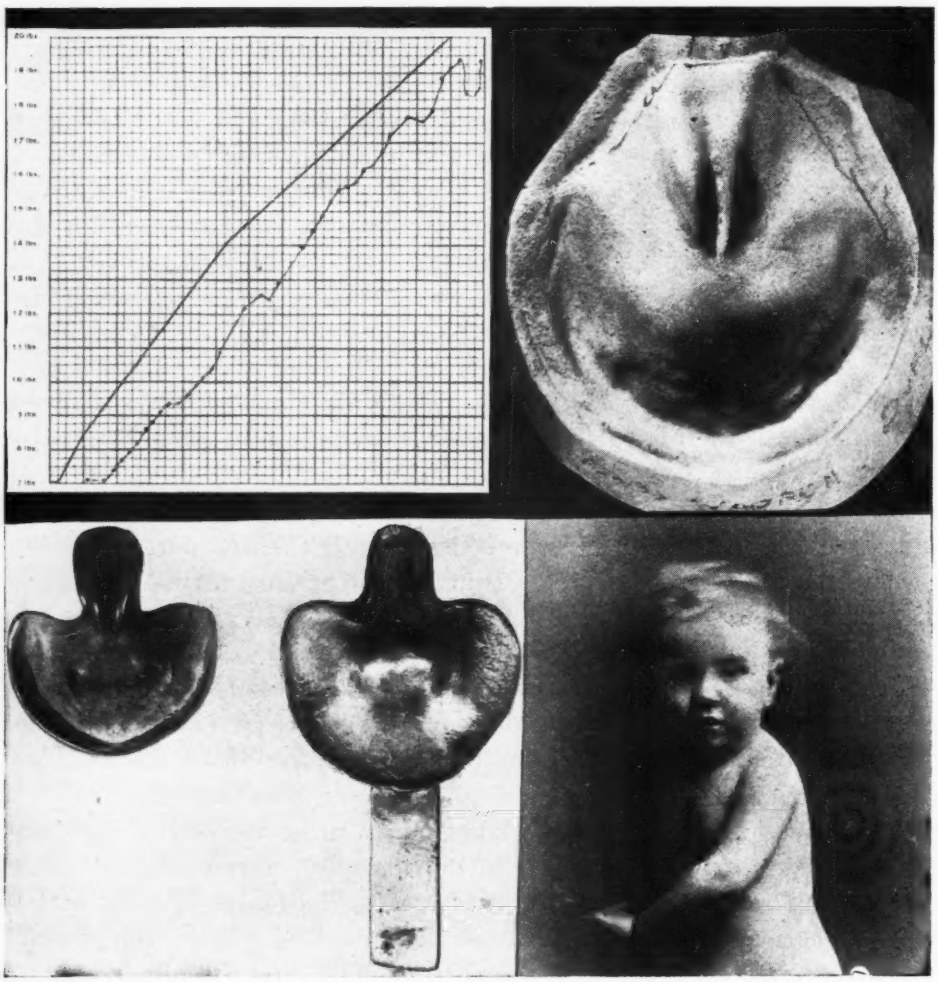


Fig. 1.

thirty minutes, average amount of breast milk 5¾ ounces. February 4 5 ounces being taken in twenty minutes, average amount of breast milk 6⅛ ounces. February 11 5 ounces was taken in fifteen minutes, average amount of breast milk 6¾ ounces. On February 12, 1925, the case was discharged from the ward. On discharge the baby was sucking well and taking a full feed of 5 ounces from the breast in fifteen minutes with the help of the obturator. This was an easy case of reestablishment of the breast milk supply, and the mother responded well to treatment. She expressed about 1½ ounces more milk than the baby needed after each breast feed. Subsequent obturators were made at intervals varying from seven to ten weeks, and as

shown by the chart the child continued to make good and normal progress. I ought to state that the obturator was only worn when the child was fed, afterwards being removed and cleaned and reinserted by the mother for the next feed. I know that several of the members have had a great deal of experience with cleft palate cases, and I am hoping they will give me some suggestions which may be useful in future as I may have several other similar cases to treat, and perhaps my methods have been rather crude.

(Mr. Highton then proceeded to show a chart, models, tray, obturators, and photograph of the case. See Fig. 1.)

DISCUSSION

The President said as far as he was concerned Mr. Highton's case was aboslutely unique in treatment, and he was sure there were members present who would like to ask questions and discuss the case.

Mr. Pitts remarked that he had had under his treatment one or two such cases. Some months ago an interesting paper on the subject had appeared in the *American Journal of the Diseases of Children*, a short note of which had appeared in the *British Dental Journal*. The article had been written by two medical men, who described their experiences with babies with cleft palate. Their experience with obturators, which they had used without much success, had suggested to them to try occluding the nose from the outside. If air passed through the nose into the mouth it reduced the pressure, and therefore a child could not get sufficient milk. The method which had suggested itself to them was the following: A strip of rubber dam was tied round the head, and passed over the nostrils. The nurse lifted the end up and down between each suction, so as to allow the child to take breath. Apparently it had acted quite well. Data were given of several infants treated in that way, which showed an increase in weight. It was obviously a very simple device, whereas the method of using an obturator in the case of a baby was far from being simple; and he would suggest to Mr. Highton that if he had another case he should try the method just mentioned. It was so very simple that it did not take up any particular amount of time, and if it failed Mr. Highton could then go on and make an obturator. In the view of the writers of the article the heavy mortality of life in cleft palate babies was really due to malnutrition owing to the fact that they were unable to get enough food; it took them so very long to get any food that their muscles became tired out. They were unable to continue for any time, and thus became undernourished and so fell ready victims to infection. He would like to ask if Mr. Highton had made his obturator of vulcanite.

Mr. Highton replied in the affirmative.

Mr. Pitts said that in the cases he had had under treatment he had used a soft rubber, as the impression obtained was of a somewhat sketchy order, and one could not always be certain of its accuracy. If soft rubber was used, even if it did not quite fit the palate accurately he did not think it mattered very much.

Mr. Kelsey Fry remarked that he had had under his treatment about 350 cleft palate cases. He had had 60 patients within the first week of life. It was necessary to get these patients as soon as they were born, because if they were going to get the mother's milk the sooner it was started the better. If the patient came about a fortnight after birth, and the practitioner was going to make an obturator and get the patient on to the breast, that lost fortnight made the case more difficult. Whether it was a right cleft or a left cleft or a double cleft, the practitioner should carry a stock of trays. Every mouth was the same, and only four trays were needed—one for a right cleft, one for a left cleft, and one for a double cleft, the fourth being necessary where the premaxilla protruded. The legs of the child were put on the nurse and the head on the practitioner's lap. As soon as a finger was put into the child's mouth it started to cry and then in went the tray. There was no difficulty about taking the impression, because as soon as the tray was in position the child, either because it was hungry or because it thought it was getting something, sucked on the tray. The practitioner waited until he thought it was sufficiently hard; the child cried again, and out came the tray. There was no difficulty in getting an impression of a child who was one day old.

It was much more difficult to take the impression of a child a year old because it was not quite so easy to handle. Having got the impression, he then made a soft rubber plate, with one strip of hard rubber running across the palate, to give rigidity to the plate. He also put on a little metal loop, which was rather useful, because the nurse was able to tie a piece of string or silk on to the plate—as the plate required some removing when the child had had the plate in and had sucked on it. The nurse just pulled the string or silk and the plate came out. After explaining the method to the nurse it was very seldom necessary for the practitioner to see the patient again. The plate was very useful for feeding, and what was still more important, the child did learn to suck, and the cleft approximated. If a record of models were kept it could be seen that in the first three months, in spite of no operation on the lip, the cleft would approximate according to the amount of work which the child did. For that reason when a practitioner made his plate he should make allowance for the cleft to approximate; otherwise if he put in a plate and carried it right up in the cleft, the approximation of the cleft would probably be hindered. That had been brought to his notice after having made a plate for a very small child, and he had been astounded that the child had broken the plate; he had not been able to see how it could break a piece of hard vulcanite. He took another model, and it had then become obvious that the cleft had approximated. Therefore he always now relieved heavily in the cleft in order to allow the two parts of the maxilla to approximate. If a child had a harelip or a double harelip the plate had to be carried up into the cleft, and again the value of the plate in such cases was that the child could feed. As to the breast, it depended largely on the amount of milk supplied. If there was not much milk, the child would not be able to get it; but if there was a fair supply of milk there was no difficulty. Another value of the plate was that the operation on the harelip was not quite so necessary; it need not be done so soon, and if the practitioner could wait for three months the cleft would approximate, and there would be more tissue available, and the plastic surgeon could more easily operate. If any member desired to see the plate personally he would be pleased to show it. He did not always carry it quite so far back into the nasal pharynx as Mr. Highton had shown. He did carry it back as far until the patient was about 3 or 4 years old.

Mr. Highton thanked Mr. Pitts and Mr. Fry for their valuable suggestions. He had had the same experience himself as Mr. Fry had had with regard to taking the impression. He had found the child had quite easily taken in the tray, and once the tray was in position it had sucked vigorously, and had not troubled about it being there at all. He had been very pleased to hear the ideas of Mr. Fry on the matter, as the case was quite an experimental one on his own part, and he had had no previous experience of cleft palate cases.

TWO CASES OF ANGLE'S CLASS II IN THE SAME FAMILY*

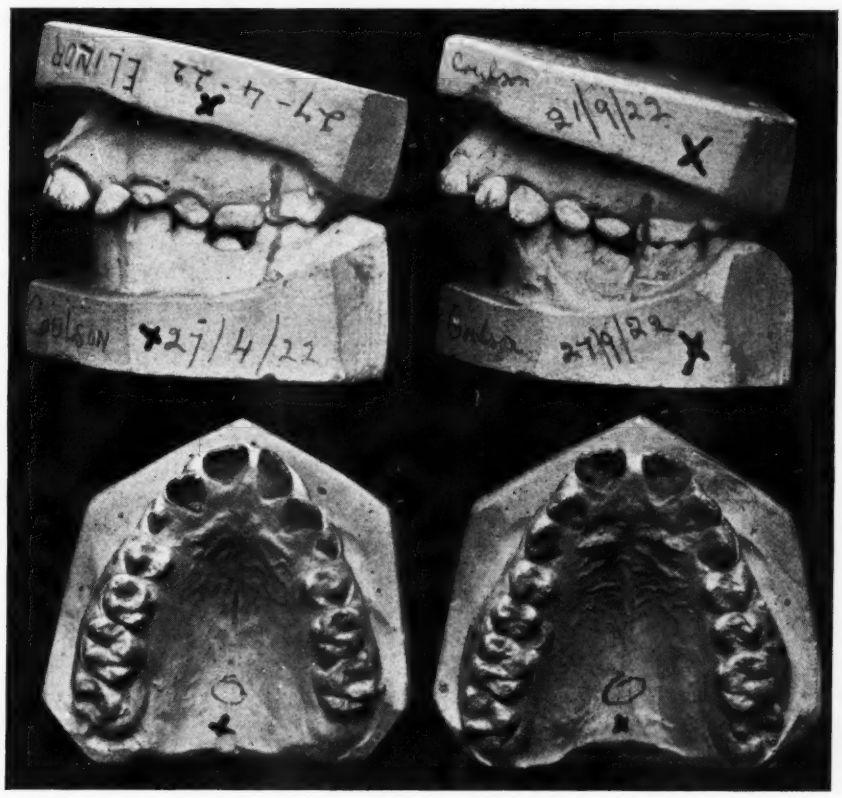
By W. A. Bulleid, L.D.S., London, England

MR. BULLEID said he was afraid that the case was an extremely trivial one, but he brought it forward in the hope that it would be a sort of peg on which to hang a short discussion. The only point of interest in the case lay in the degree of deformity and in the similarity. The children were brother and sister. When he had first seen them the boy had been twelve years old and the girl ten. Seeing that they were two children of the same family and so near to the same age, he thought it was a reasonable inference that, whatever influences were at work producing the deformities, they must be the same. The members would see from the photograph that the appearance of the children was really very hideous. He did not often speculate as to the etiology of cases. There was nothing remarkable in the history at all. They

*Transactions of British Society for the Study of Orthodontics.

were well-developed children for their age. There was no history of rickets. Both children were full term, both were breast fed, and neither had had any child illnesses nor adenoids. He had wondered if there was an hereditary factor involved. He had questioned the mother and father, who were themselves quite normal, on that point, but they did not know of any members of the family who had shown any such deformity. There had been nothing abnormal about the children's deciduous dentition. He thought any hereditary factor could be definitely excluded.

He had come to the conclusion—and it was on that that he wished some enlightenment from the members—that whatever factor had produced the de-



formities was of a local nature. There was nothing abnormal about the children at all except their jaws.

What had made him think that the condition was purely local and not very deep-seated, was the ease with which the deformities had been corrected. The girl had become normal in eight months, and the boy had taken rather longer. If there had been any hereditary factor, he did not see how the correction could have taken place so quickly. As there had been no tendency whatever to relapse, he was inclined to think that some obscure force was acting locally.

(Mr. Bulleid then showed a photograph and models of the cases.)

DISCUSSION

The President thought the cases were extremely interesting, but it would take an immense amount of time to go into their etiology.

Mr. Bulleid thought there was something perfectly local in connection with the case.

The President said they were not marked in their occlusion. It was rather difficult to understand whether they were both bilateral.

Mr. Bulleid said it was almost bilateral, as a matter of fact.

The President asked if, upon the eruption of the permanent canines, they had erupted very much wider than the deciduous canines which, on a casual glance, might have given a backward action on the mandible.

Mr. Bulleid replied that when he had started treatment the canines had erupted. In the boy the deformity was more advanced. He was two years older. They were exactly the same, except that in the boy it was slightly more advanced. They were absolutely bilateral.

Mr. Northcroft inquired if Mr. Bulleid had models of the completed case, and also if Mr. Bulleid would be good enough to show the models of the case in about a year-and-a-half or two years from now. He thought it was so fortunate that the case had been completed so rapidly and remained in such good position and that it would be most interesting to place the models in the museum after a lapse of time.

Mr. Bulleid said he had the models and would hand them round.

Mr. Marsh asked if Mr. Bulleid could say anything about the condition of the nasal passages in the children. As far as he could see from the rather badly illuminated photograph, the boy had quite nice wide nostrils, but he would like to know if an investigation had been made on the condition of the children's nasal septa.

Mr. Bulleid said so far as he knew the nose and throat had not been examined by a specialist, but the mother had assured him—and he had seen no evidence to the contrary—that both children were nose-breathers and neither of them had ever had adenoid growths removed. Their tonsils were not particularly enlarged, and the throats on the whole were perfectly healthy.

Mr. Chapman said the model which he was about to exhibit illustrated the case which he had desired to show in connection with Mr. Stedman's paper at the last meeting. It was a case which it was decided to treat by extraction. (Mr. Chapman then exhibited the model.) He had merely brought the case forward to show that the extraction method was extremely simple sometimes, but that unfortunately it did not always work in the way in which it was desired or expected to. In this instance a mandibular central was removed to permit the instanding lateral to come into place, there being more than enough room for it. However, instead of this happening, the space closed in the course of one year so that instead of there being ample room for the lateral it was definitely shut out from the arch.

The President said the members were very much indebted to Mr. Chapman for bringing the case forward. It displayed a great amount of courage, and the Society was very grateful to him.

Mr. Maxwell Stephens said no doubt many of the members could bring forward similar cases. He could remember two of his own, from which he had learned that if one removed lateral incisors in such a position, it was very necessary to maintain the width of the arch, because there was a flanking of the arch on that side, and apparently the canine and premolars moved inwards; and that was where the space was taken up.

Mr. Packham asked Mr. Bulleid what treatment the children had had in the way of apparatus.

Mr. Bulleid replied that he had used the Angle ribbon arch. He had banded the four mandibular incisors, and had used ligatures on the premolar. He had used expansion on both arches and maxillary traction, and a depressing force on the mandibular incisors. There was nothing very creditable in it. The apparatus had been put on the girl in August; he had seen her eight times, and on the ninth he had taken it off.

Mr. Packham said he had found, during his short experience, that such cases were extremely difficult to treat, and he congratulated Mr. Bulleid very heartily on his successful result.

Mr. Bulleid said the cases had responded so easily that he had been driven to the conclusion that it was purely a local condition.

Mr. Packham then brought forward a case showing nondevelopment of teeth. It was interesting, and so far as he knew, distinctly uncommon in the respect that the members would see that on the left side in the maxilla the canine was absent, and on the right side the first premolar. Symmetric nondevelopment of teeth was anything but rare, but so far he

had not seen a case of assymmetric nondevelopment of teeth. (Mr. Packham then proceeded to show slides of the case.) The child was postnormal, and some years ago treatment had been started by capping the deciduous teeth and bringing the mandible forward, allowing the first molars to overerupt. He had noted that, after she had worn the plate for several months, satisfactory progress was being made. The first molars were overerupting, and opening the bite nicely. The first deciduous molars, however, seemed to be bitten into the gum. That point was illustrated very well on the model, where it could be seen that they were almost covered by the gum. It was the assymmetric nondevelopment of the two teeth that he wished to bring to the notice of the Society that evening.

Mr. Maxwell Stephens said he had been examining the photograph of Mr. Bulleid's case, and he would like to ask if Mr. Bulleid had a photograph of the completed cases, because it was frequently the fact that a girl and a boy, in their heights and type of face, were different. Sometimes one had an oval face, and the other had a square type of face. The cases under discussion had both been expanded by the same method, and it would be extremely interesting, as they grew, to observe the types. There might be more teeth visible in the girl, who had an expanded arch, if she had an oval type of face, whereas in the boy it might be perfectly natural.

Mr. Bulleid said as far as the shape of the face was concerned, the boy's was far more massive in every way than the girl's. It was a very broad, square face. The girl had a more oval type of face. The boy showed the teeth more than the girl, but neither of them to any abnormal extent.

Mr. H. Chapman said he presumed from what Mr. Bulleid had said that the assumption was that the cases were originally normal until a certain time. If the irregularity was due to a local cause, apparently the arches must have been normal before that local cause had come into operation. It seemed to him that until someone showed such a case before it had become abnormal and after it was abnormal, too much reliance could not be placed upon that—not that he had any reason to doubt what Mr. Bulleid had said, but he did not think there was sufficient evidence. He could not conceive how a normal occlusion could possibly get into the condition that either of the cases shown had got into, and it seemed to him then that the case must be antenatal. Whether hereditary or not it was more difficult to say. The children looked to be of good general physique. He had tried to show in his paper at the corresponding meeting last year that it was more than likely that such children did not really have good physique—and when he said that he referred to the time of birth, because he believed that those children could become practically normal as regarded their physical development as they grew up. One frequently saw boys and girls who were really fine specimens of childhood and yet had teeth which were a great disfigurement to them. Therefore it was quite possible that the children under discussion might have had much weaker physiques at the time of birth and in the first years of life than they had at present. One had to go very carefully into the history of such cases to discover that. He did not know whether Mr. Bulleid had gone into those minute details, but he thought if he did it was possible he might discover something. In one case, which he had shown at another meeting, he had personally found that the boy had very thin finger nails, among other defects, which showed that his physical condition was not good, although if one saw the boy one could hardly say that he was worse than his brother, who had a normal occlusion and a better history. Another point which he had noticed from the photographs was that the upper lip was rather short and curved up, exposing the central incisors, and that the lower lip was well behind those teeth. It seemed to him in such cases that whilst the children were probably nasal breathers at the time, they were not immune from mouth breathing at the same time, or anyhow during a portion of the twenty-four hours. He did not look on that as a factor, but rather that the mouth breathing was a result of the position of the teeth. Therefore he thought it was most important, if one was going into the etiology of the cases, to examine very carefully the earlier history, and not only the history of a year or two before the cases were seen.

Mr. Packham suggested that he should send to Mr. Bulleid the forms which were got up in considerable detail, and ask him to fill them in. As Mr. Chapman had just said, the detailed early history of the cases would be intensely interesting.

The President said if Mr. Bulleid did attempt to fill up the forms he would like him to put in the fact as to whether or not there had been any symptoms of anemia in the children at any time.

Mr. Bulleid thanked Mr. Chapman very much for his remarks, which were just the sort of remarks he had hoped the communication would bring forward. He had started out by speculating on the etiology of the cases, and he was speculating still. As a matter of fact he had applied for much more elaborate details of the early childhood of the children, but unfortunately the mother had had to undergo a serious operation, so he had not been able to obtain all the details for presentation before the members that night. The mother was a very intelligent woman, and he had not been able to get out of her anything as to any ill-health of the children in their childhood. The point that had struck him most about the cases was the speed at which the girl's mouth had returned to normal. If it was a deep-seated developmental defect he failed to see how it had got well so quickly. He would gladly fill up any forms the Honorary Secretary might honor him with.

RESULTS OF A YEAR'S TREATMENT WITH MERSHON LIGHT AUXILIARY SPRING PRESSURE*

By Raymond L. Webster, D.M.D., Providence, Rhode Island

IN PRESENTING these cases which are now under treatment with the lingual arch and auxiliary springs, I do so not to show any phenomenal results or appliances but merely to show the results of my interpretations of the teachings of Mershon relative to correction by slow stimulation. Each case that I am now showing has the original set of models and a set just made on which are the actual appliances with which I am treating the case. These appliances are to go back into the patients' mouths upon my return. Since using this form of appliance quite extensively, I have made the following observations:

The construction of the appliance as compared with some others is not complicated, but to obtain the maximum amount of efficiency with the light auxiliary springs, the technic, such as shown by Oliver on several previous occasions, should be followed in every detail.

It should always be borne in mind that the least pressure that can be exerted by an auxiliary spring is sufficient.

The adjustments should not be frequent.

It has the following distinct advantages:

Lack of rigid attachments to individual teeth, except on the anchor teeth, allow normal individual movement at all times, with no functional interference, thus eliminating sore teeth.

Its position does not interfere with any natural labial development which might take place, or with the muscle actions.

The lack of conspicuousness is an important factor with the older patients.

While all are familiar with lingual arches and the so-called finger springs, I doubt if even now many appreciate what can be done with the light auxiliary springs or the principle in back of them. Needless to say, in certain types of children an appliance with such delicate attachments as these would not be indicated, or in cases where a purely mechanical problem had to be solved a more rigid appliance might be necessary, but the more I use this appliance, the greater I find its possibilities.

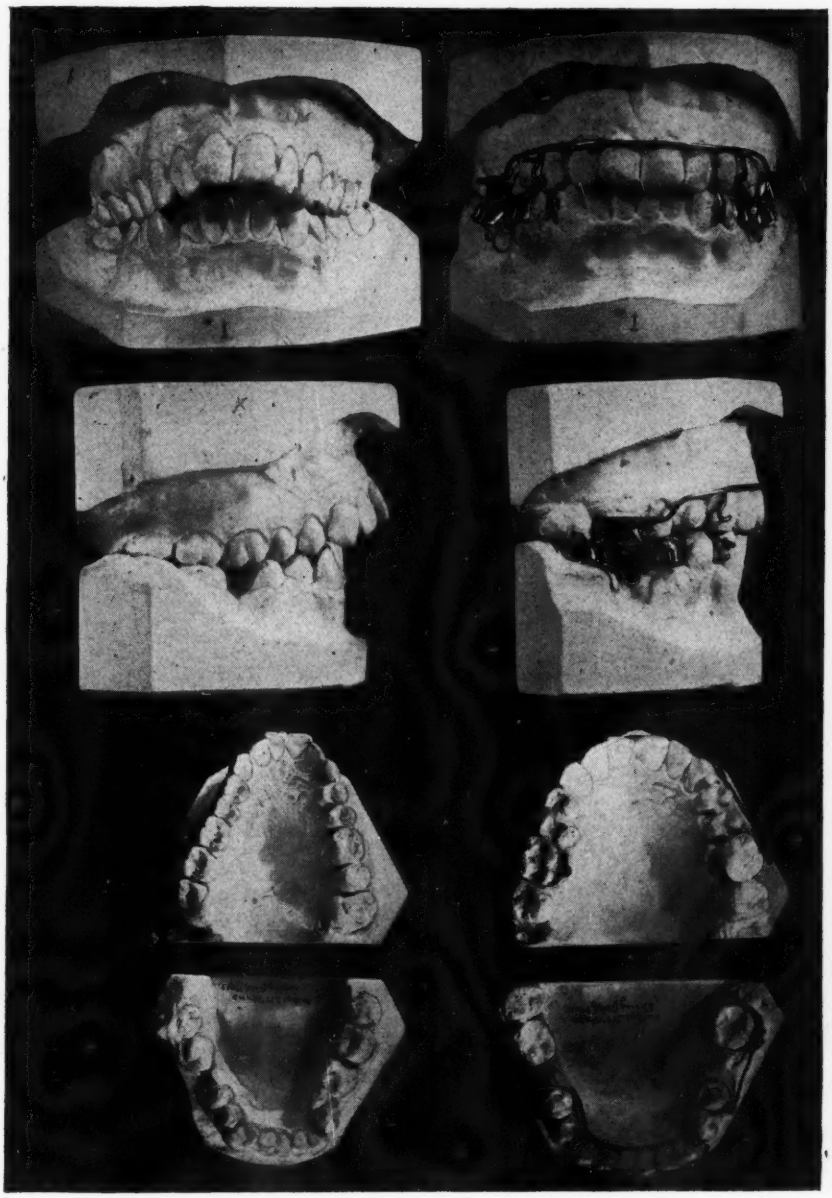
*Clinic presented before the Twenty-sixth Annual Meeting of The American Society of Orthodontists, Chicago, May 2-5, 1927.

METHODS OF TREATMENT (CASE REPORTS)*

By Dr. Paul J. McKenna, Springfield, Mass.

CASE 1.—In this report I wish to show the result in the treatment of a mutilated distoclusion (Fig. 1).

The mandibular left sixth year molar had to be extracted before starting treatment, because of the presence of a pathologic condition.

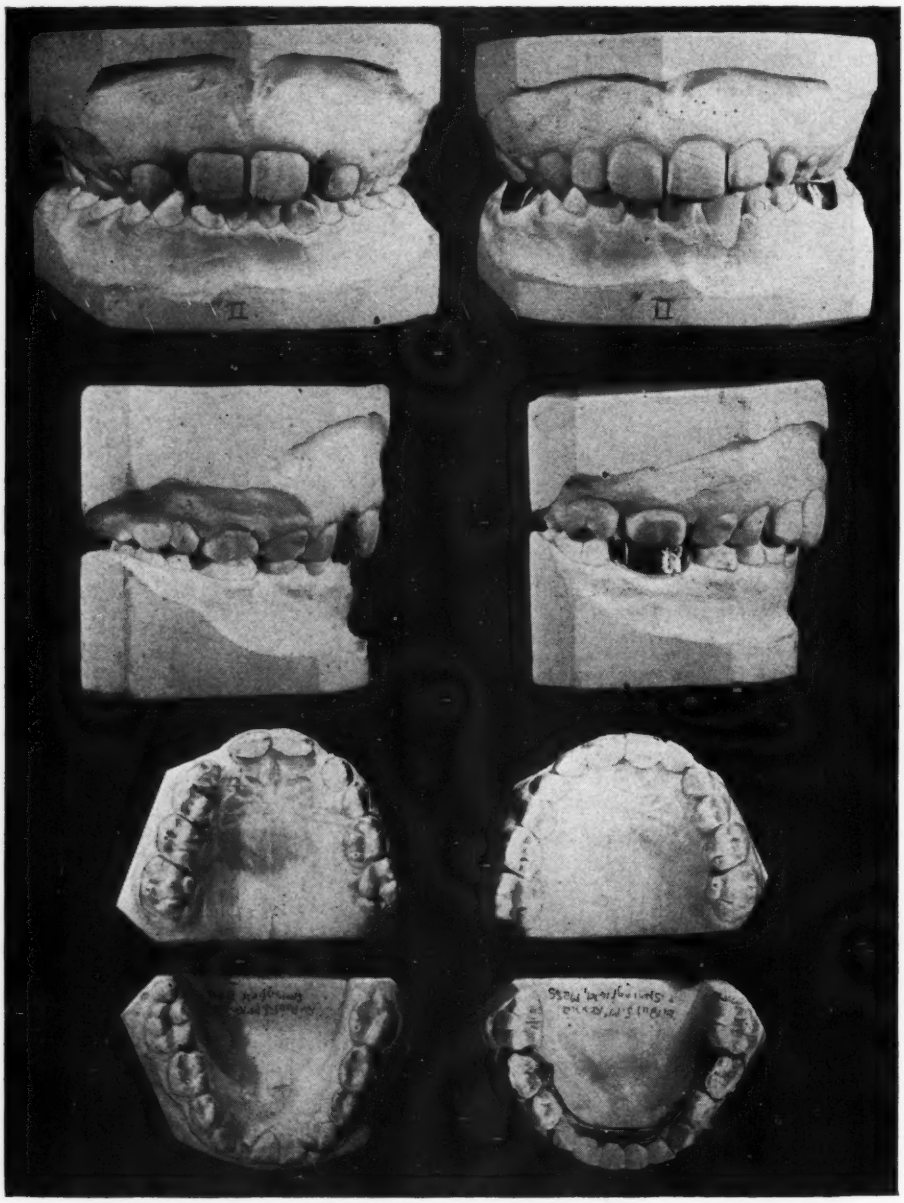


Before treatment. After treatment.

Fig. 1. Case 1.

*Presented before the First International Orthodontic Congress, New York City, August 16-20, 1926.

I wish to have you note the maxillary arch, as this girl although seventeen years of age, was a thumb-sucker. She was treated two years. You will note the result together with the appliance used during treatment, also, the numerous attachments for intermaxillary elastics, in correcting both the disto- and infraclusion of the case.



Before treatment. After treatment.

Fig. 2. Case 2.

CASE 2.—In this case I wish to present the models of a child's mouth, showing the appliances used in the expanding of the mandibular arch (Fig. 2).

This child was seven years of age and was treated for nine months. It is interesting to note the simplicity of this treatment and the expansion obtained in the maxillary arch, through the stimulation of the mandibular arch.

Case 3.—This case is of a boy fifteen years of age, showing a method of bringing down a canine (Fig. 3).

After the maxillary right first premolar was turned by means of a finger spring on the lingual arch, the canine started to come down, but very slowly,

Before treatment. After treatment.

Fig. 3. Case 3.

so I put a band on it and both stimulated and directed it by the buccal spring soldered to the molar band. The time required in the treatment of this case was sixteen months.

CASE REPORT SHOWING APPLIANCE FOR THE CORRECTION OF SUBMERGED TEETH*

By John A. McPhail, D.D.S., Cincinnati, Ohio

SUBMERGED teeth have caused orthodontists a great deal of trouble. Not many years ago most of them were either left in their malpositions or extracted. There never will be any substitute for a natural tooth, therefore, every possible effort should be made to bring these teeth into their normal positions. The methods used here have been used by others. From the mass of material on the subject the method described in the following paragraphs has been most satisfactory.

A boy nine years of age presented with an unerupted maxillary incisor. It seemed if sufficient space were secured this tooth would erupt of its own accord. (See radiogram Fig. 2, June 19, 1923.)

The family dentist possessed radiograms taken in 1919 when the patient was five years of age. A short time previous to this he had had an accident which had devitalized the right deciduous maxillary incisor and no doubt changed the position of the permanent central incisor. This temporary tooth was treated and root canals filled, which gave him considerable trouble. In February, 1923, it was extracted. This boy has always had a very late eruption of teeth. Although he is twelve years of age he still retains quite a number of the deciduous teeth.

The case was started and in about eight months the size of both arches was increased. The occlusion of the posterior teeth was improved and sufficient space for the unerupted central obtained. An appliance was made to retain this space and case was allowed to rest. (Radiogram July 12, 1924.)

He returned after his vacation and a digital examination showed that the tooth was just where it was when we started the work. More radiograms were made, but the tooth was not yet definitely located.

It was then decided to make a negative showing the entire face in profile. (Radiogram September 9, 1924.) This disclosed the fact that the incisal edge of the tooth was pointed upward and outward. Although the boy was ten years of age this radiogram and others revealed the fact that the root was poorly developed. The parents hesitated to have the tooth exposed. However, in January, 1924, it was decided to expose the tooth and attempt to bring it into place. Under local anesthesia the crown was exposed and found to be located high up under the labial fold and partly behind the frenum, making it quite difficult to place an attachment or to use an appliance.

Before exposing the tooth, the teeth had been separated for molar bands. The bands were placed on the teeth, an impression was taken and a lingual wire soldered close to all the teeth, buccal tubes were soldered to the bands and a labial arch made to fit contour of arch, with two hooks soldered about one-fourth inch anterior to buccal tubes.

*Presented before the First International Orthodontic Congress, New York City, August 16-20, 1926.

After the exposure of the tooth a packing was placed in the pocket. Punk and other materials have been used for this purpose, but cotton saturated with chlora-percha has been found to be better where it is necessary to press the soft tissues away from the exposed portion of the tooth while they are healing. It is then much easier to gain access and place the attachment on the tooth. Where the exposure is sufficient, temporary stopping is quite useful. Press it in cavity while soft and chill.

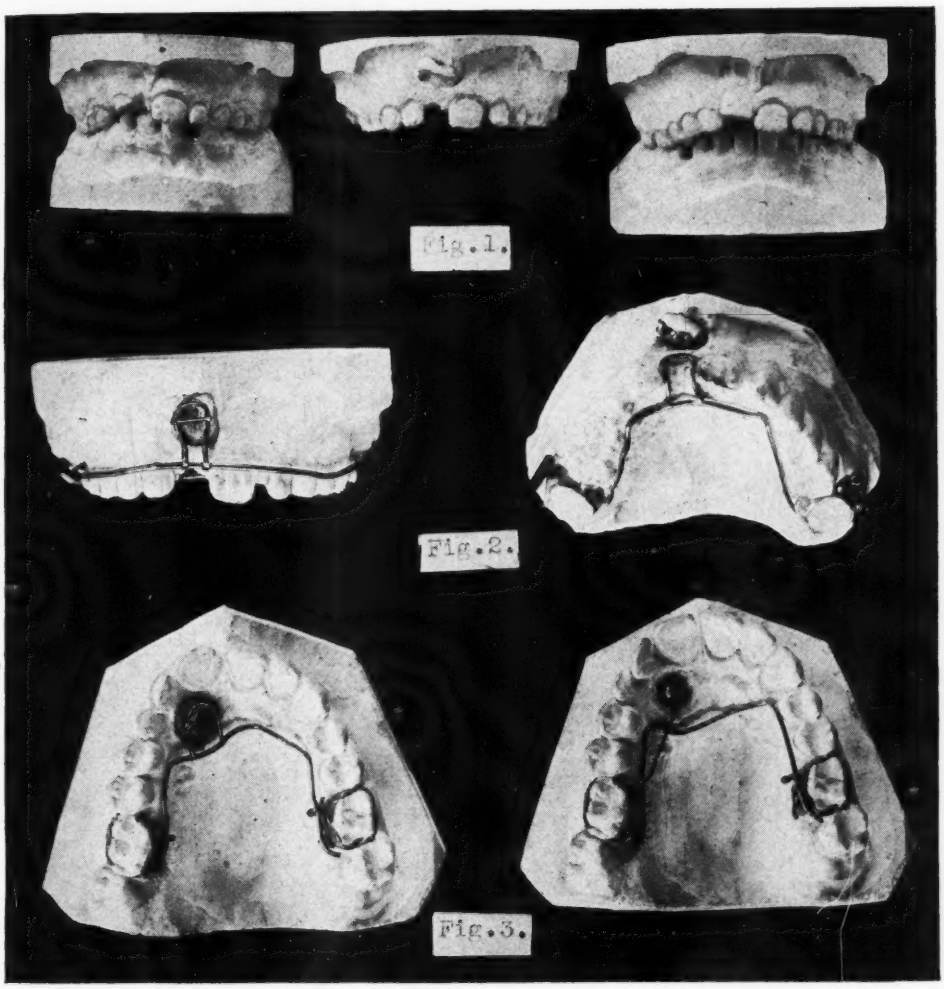


Fig. 1-*A*.—Case 1. Note presence of erupting maxillary lateral incisor, maxillary central incisor submerged June 19, 1923.
B. Central incisor partially erupted June, 1925.
C. Showing progress, 1926.

Fig. 2.—Radiograms showing progress of Case 1. Note root development.

Fig. 3-*A*.—Following operation for exposing crown of tooth. This appliance is used to hold packing of temporary stopping over crown of exposed tooth in order to gain access for fitting band or onlay.
B. Appliance used to maintain space for erupting central incisor. The erupting central may be directed into position by tying ligatures to the appliance, thereby making it unnecessary to use labial arch.

It is quite difficult to keep a packing of any kind in the pocket. This is accomplished by adding a loop to the appliance. Fig. 3-*A* illustrates a method of using it on the labial arch. The loop should rest on the packing and the arch should be about a sixteenth of an inch from the teeth. In Case 1, hooks

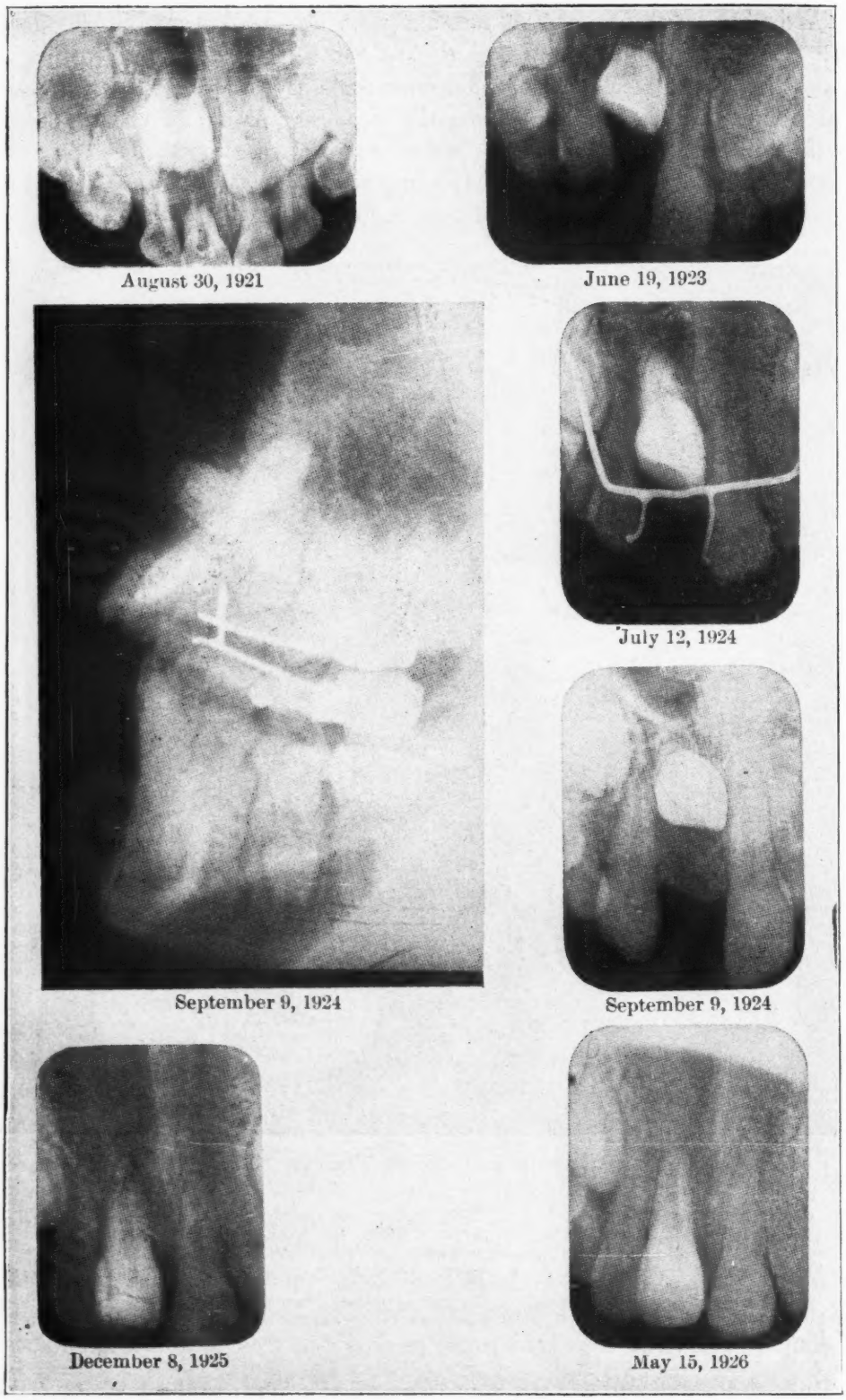


Fig. 4-*A*.—Appliance holding packing in place after exposure of submerged canine. When packing, lift appliance slightly so that it will exert pressure on packing when released.

B. Same appliance as in Fig. 4-*A*. with loop which holds packing in place removed. The onlay has been cemented on exposed canine. The auxiliary wire has been added to the appliance and attached to the onlay.

were added to the labial arch just anterior to the buccal tubes. A wire or ligature may be tied from hooks to distal of buccal tubes. When ligature is tightened the arch is pulled distally and the loop exerts any desired degree of pressure on the packing. In Fig. 4-*A* the appliance was lifted up before packing. This spring pressure keeps the packing in place and pushes away soft tissues.

In deeply submerged teeth it is difficult to place an attachment on the tooth. Posts cemented into holes drilled in the crown of the tooth are unsatisfactory. A much more desirable method is to obtain an accurate impression of the exposed portion of the submerged tooth using a specially constructed ferrule filled with modeling compound. Metal dies are then made and an onlay either cast or swedged is made. To the onlay is soldered a hook or ring to which is attached an auxiliary spring or other attachment.

In connection with submerged teeth there are several important points to be observed.

A careful check-up following accidents to temporary teeth should be made.

The submerged tooth should be accurately located radiographically.

Periods of rest should be given at regular intervals.

Observation of teeth should be made for some time after correction.

American Dental Assistants Association

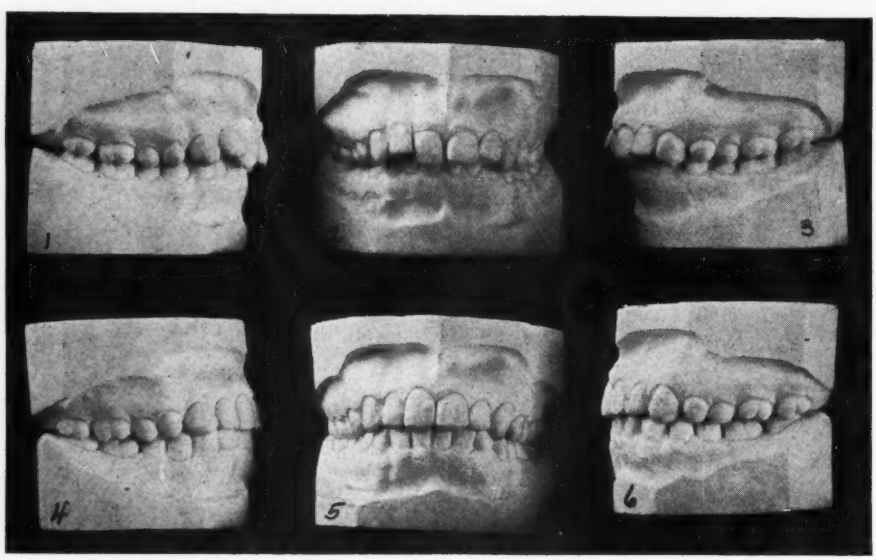
The Fourth Annual Meeting of the American Dental Assistants Association will be held in Minneapolis, Minn., August 21, 22, and 23, 1928. General headquarters will be at the Leamington Hotel.

Ruth F. Rogers, Secretary,
Suite 1760, 16 N. Wabash Avenue,
Chicago, Ill.

REPORT OF CASES*

By Dr. Frank M. Casto, Cleveland, Ohio

THESE cases are not reported because of their presenting an unusual type of malocclusion; they do not; in fact, they are rather common types. They are reported because of the ease and rapidity with which they were treated by the use of the removable lingual arch appliance, in connection with the high labial arch. Further, the treatment of these cases in the past has met with considerable resistance and has required or at least seems to have required a much more complicated appliance and a longer period of treatment. The impressions from which the casts shown in the illustrations were



Figs. 1, 2 and 3 are illustrations made from photographs of the casts of the case before treatment.

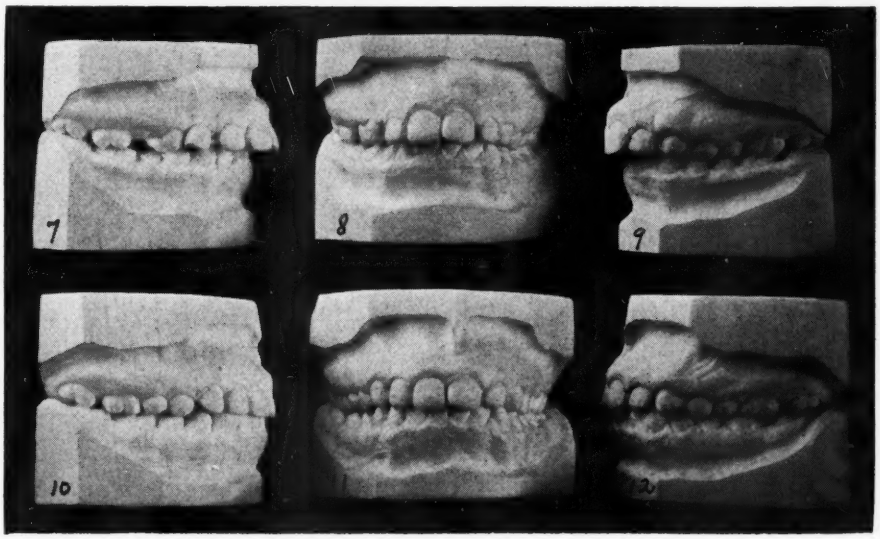
Figs. 4, 5 and 6 are illustrations made from photographs of the casts of the case after the removal of the operating appliances.

made, were taken shortly after the operating appliances were removed and all of the teeth have not quite settled into their correct positions, working retainers were placed which will complete the work.

Case 1.—Class I, Angle classification. Patient, female, age sixteen years. The case presented slightly less than an end-to-end bite in the molar and premolar region, the tendency of the cusp relation being to a correct mesio-distal relationship. A deep overbite. The mandibular incisors were somewhat extruded in lingual version and pressing into the soft tissues lingual to the maxillary incisors. The mandibular arch was contracted in the region of the cuspids and first premolars. The maxillary arch was contracted, the right lateral incisor in labioversion, the right central incisor extruded, the

*Presented before the First International Orthodontic Congress, New York City, August 16-20, 1926.

left central incisor in torsiversion and the right lateral incisor in labioversion. The appliances were placed upon both the maxillary and mandibular arches March 3, 1926. The mandibular appliance was a removable lingual arch which carried lateral recurrent finger springs adjusted so as to carry the premolars buccally and the cuspids and incisors labially. The maxillary appliance was a removable lingual arch and a high labial arch, recurrent finger springs were placed upon the lingual arch to carry the premolars buccally, and a small bite plane attached to the anterior part. To the high labial arch were attached finger springs for the purpose of moving the lateral incisors lingually, intruding the right central incisor and rotating the left central incisor. No bands were used except upon the first molars. The patient reported at the office for observation or adjustment of the appliances, every two weeks. Ad-



Figs. 7, 8 and 9 are illustrations of casts made from impressions at the beginning of treatment.

Figs. 10, 11 and 12 are illustrations of casts made from impressions at the time the operating appliances were removed.

justments were not always necessary. The appliances were placed March 3, 1926, removed June 24, 1926, and retaining appliances were placed July 1, 1926.

CASE 2.—Class I, Angle classification. Patient, female, age eleven years.

This case presented the following:

First: Both maxillary and mandibular arches were contracted.

Second: The maxillary anterior teeth were in labioversion, the left central being rotated.

Third: The bite was deep, causing the mandibular incisors to press heavily against the soft tissues lingual to the maxillary incisors, this as in all similar cases was forcing the maxillary incisors further labially.

Fourth: The mandibular arch was shortened by the linguoversion of the incisors. The incisors were also elongated, the laterals being in slight torsiversion.

APPLIANCES

Maxillary arch: A removable lingual arch, crossing the palate just anterior to the first premolars, was placed, upon which was soldered recurrent finger springs for the purpose of carrying the premolars buccally; the arch was adjusted so as to carry the first molars buccally to a slight degree, a high labial arch was used upon which was soldered finger springs for the purpose of moving the incisors lingually, and at the same time intruding the centrals by bending a loop over the incisal edges. Hooks were also attached for the use of the intermaxillary elastics.

Mandibular: A removable lingual arch was placed upon which were attached recurrent finger springs for the purpose of carrying the premolars buccally, the cuspids out and the incisors labially, the laterals being rotated as they were carried forward. Lugs were soldered to the buccal surface of the molar bands for attachment of the intermaxillary elastics. The thing which is of particular significance and of interest in this case was the inaccessibility of the patient who resided in a far distant part of the country. There was no orthodontist within many miles of her home and it was more convenient to make an occasional visit to Cleveland on account of relatives residing here. Therefore, I accepted the responsibility of treating the case. The appliances were placed June 23, 1925, adjustments were made July 2, 1925, the case was then kept under observation until August 15, 1925, when the final adjustments were made and the patient left for home. I gave careful instructions regarding the proper care of the mouth, with further instructions to visit a dentist, who by the way, was about one hundred miles distant, once in six weeks for a prophylactic treatment, or oftener should occasion demand. The patient returned December 21, 1925. The mouth and teeth were in splendid condition and the work was progressing beautifully. The final adjustments were made on January 2, 1926, and the patient left for home again. She did not return until June 21, 1926. The appliances were removed and impressions taken July 29, 1926. Suitable retaining appliances were placed and the patient left August 12, 1926. I expect to see her again during the coming holidays when I hope to find the teeth, under the influence of retaining appliances, settled into satisfactory positions.

DEPARTMENT OF

ORAL SURGERY, ORAL PATHOLOGY AND SURGICAL ORTHODONTIA

Under Editorial Supervision of

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THE LYMPHOID STRUCTURES OF THE ORO- AND NASOPHARYNX*

By Louis Dienstag, M.D., New York City

YOUR program committee is to be congratulated on its appropriate choice of subject: first, because all of you in your daily work are constantly in close contact with the lymphoid structures of the naso and oropharynx; and secondly, because pathologic changes in these structures very likely produce indirectly structural changes of the facial bones, with consequent deformities which are interesting to you as orthodontists.

The lymphoid tissues of the upper respiratory tract consist of:

1. The pharyngeal tonsil commonly known as "adenoids."
2. The faucial, or palatine tonsils.
3. The lingual tonsils.
4. The tube tonsil of Gerlach.

I shall but touch briefly on the two latter, which are of relative unimportance functionally and pathologically. The tube tonsils of Gerlach are small masses of lymphoid tissue, situated when present at the pharyngeal opening of the eustachian tube in the fossae of Rosemuller. In structure they are similar to that of the faucial tonsils, which shall be described later on. They in no way contribute to any deformity of the facial bones.

Persistent recurring otitis media in children, I believe, is very often due to a low grade infection present in these small masses of lymphoid tissue. Then, again, they may become quite large and cause a blocking of drainage of an acute otitis through the tube. In the removal of adenoids they may often be missed by the adenatome, and thus overlooked, give rise to a recurrence of adenoid tissue in the nasopharynx.

The lingual tonsils are quite constant. They are situated at the base of the tongue behind the circumvallate papilla and just in front of the epiglottis. They consist of masses of small rounded projections each presenting a small visible pit at the center. Most of these are similar in structure to the lymph follicles found in the palatine tonsils plus a greater amount of

*Read before the Dewey Study Club, May 15, 1927.

connective tissue; others are said to be mucous glands. All are covered by a smooth mucous membrane giving to this region a characteristic nodular appearance. Their definite function, if any, is unknown, except that they may act, like most lymph tissue, as filters of infection.

Pathologically, they rarely give trouble, except that they may become hypertrophic and cause interference with swallowing and respiration or give rise to a nervous state in some patients bordering on hysteria due to a feeling of a lump in the throat, the so-called globis hystericus.

Hypertrophy of the lingual tonsils is more common in adults than in children and in this respect differs very markedly from the lymphoid tissue found in other regions of the upper respiratory tract where the tendency to hypertrophy is so much more marked in childhood. It is more common in females than in males and is frequently associated with a varicose condition of the veins at the base of the tongue. Pathologic conditions here, I believe, do not cause any bone changes.

The palatine tonsils are two large oval masses of lymphoid tissue embedded in the side walls of the oropharynx in a triangular area, the sinus tonsillaris. Posteriorly, they are bounded by the pharyngopalatine arch, anteriorly by the glossopalatine arch, below by the side of the pharyngeal portion of the tongue, and above a depression, variably developed and known as the supratonsillar fossae. The medial surface of the tonsil is prominent and freely studded with pit-like depressions or crypts. The lateral attached surface is enclosed in a distinct fibrous capsule which separates the tonsils from the superior constrictor muscle of the pharynx and deeper structures of the neck.

Each tonsil is composed of masses of small rounded lymphatic cells, many of which are diffusely scattered and others existing in groups with a germinal center called follicles. All are enmeshed in a delicate connective tissue reticulum. The exposed surface of the tonsil is covered by a stratified squamous epithelium which dips down into the organ to form irregular tubes or crypts. The inner surface of the tonsil lying in the sinus tonsillarium is covered by a capsule of white fibrous tissue which sends in trabeculae to make up the main framework of the organ.

Blood vessels, and especially lymphatics, are numerous; the former ramifying the diffuse lymphoid tissue, the latter surrounding the lymph follicles to form a peripheral vessel beneath the capsule.

Thus we see that the tonsils are really a large pair of lymphatic glands, the functions of which are but little known and imperfectly understood.

As with other lymph glands they probably protect the organism from acute infections by acting as filters of food passing through to the stomach, and air passing to the lungs.

They further, in some way lessen the toxicity of microorganisms coming in contact with them, and I personally believe that in early infancy they act as a source of immunity until such time as the growing child develops a natural immunity through the blood stream.

This accomplished, they become easily subject to morbid changes, and become hypertrophied to such an extent as to interfere seriously with nor-

mal respiration and deglutition. It is at this state, especially in early childhood when the bones are not yet fully formed, that the forced efforts at inspiration with the attendant strain and pull on the facial and pharyngeal muscles probably cause deformities of the mandible and maxilla producing a protruding lower jaw or a high arched palate. In this morbid state instead of acting as protectors against germs, they act as portals of entry for disease germs, and thus play a most active part in the etiology of rheumatic fever, acute endocarditis and chorea and by many observers are thought to be the portal of entry for tuberculosis.

The pharyngeal tonsil is situated upon the roof and posterior wall of the nasopharynx down to the level of the anterior arch of the atlas and extending laterally as far as the orifices of the eustachian tubes.

They consist of a mass of lymphoid glandular tissue similar in structure to the faucial tonsils. Deeper down in the structure there are ramifying trabeculae of connective tissue with lymphoid cells lying between them. The hypertrophic condition of this glandular tissue constitutes the condition known as "adenoids" or adenoid vegetations.

There is a greater preponderance of lymphoid elements in younger children who have not been subject to repeated inflammatory attacks or congestion of the tissue than in older children where the vegetations have been the site of various local congestive and inflammatory changes which have resulted in the deposit of inflammatory material with overgrowth of connective tissue and consequent hardening of the structure. The surface of these growths is generally very markedly tubulated or mamillated, being covered by mucous membrane.

The etiology of adenoids is obscure. It undoubtedly occurs most commonly in conjunction with hypertrophy of the faucial tonsils and is often spoken of as one of the manifestations of the so-called lymphatic diathesis. Although it occurs with marked frequency in children tainted by tuberculosis and syphilis, it is nevertheless seen in the children of healthy parents. It would seem more rational, therefore, to consider its presence in children who had inherited tuberculosis or lues as a result of the anemia attendant upon those conditions rather than a manifestation of the diseases themselves.

Climatic conditions have an undoubted influence. As evidenced by the fact that the condition is much more frequent in low damp localities with frequent changes of temperature than it is in better and steadier climates. The hereditary factor is said to also play a part in the frequency of this hypertrophic tendency, and Kyle believes that the cause of the so-called inherited tendency is frequently found in the inherited family nose. He maintains that the adenoid hypertrophy is more common in children with narrow slit-like orifices, than those with wide open nostrils. In both children and adults the condition is very frequently found associated with chronic hypertrophic rhinitis.

I can do no better than quote the further general description of the adenoids from one of the best authorities on the subject, Osler, who says in part:

"The most prominent symptoms are those which arise from nasal ob-

struction, and of these, the most striking is the appearance of the face which results from habitual mouth-breathing. Everyone is familiar with the aspect of the unfortunate beings who are unable to breathe properly through the nose. The dull, expressionless face, lack luster eyes, wide open mouth, with protruding upper lip and hanging lower jaw, accompanied by an inability to fix the mind upon a task and the general stupidity and mental dullness frequently lead to their being regarded as mentally deficient. In fact, it is this mental sluggishness to which Guye, of Amsterdam, gave the term 'aprosexia.' There is also often an associated deficiency of hearing, the result of obstruction of the pharyngeal orifices of the eustachian tubes. This deafness adds materially to the child's apparent stupidity, and they are rendered more unattractive by the fact that they are generally irritable and cross because of their constant physical discomfort."

As a result of the air not being moistened and warmed by its passage through the nasal chambers patients who suffer from adenoids are also frequently subject to inflammations of the pharynx and larynx, or even to attacks of bronchitis, asthma, and croup in children. The voice is also affected in a very characteristic manner due to the loss of nasal resonance which causes the voice to lose its natural resonance. There is also generally a great amount of mucous discharge from the nose, and the lack of ability to properly expel this causes a continuous snuffling.

Many serious ear conditions are directly attributed to adenoids, among which are chronic catarrhal otitis media, acute otitis media, and tubal catarrh. Children with adenoids are often subjected to repeated attacks of inflammation of the fauces, pharynx and tonsils, especially when the latter are hypertrophied. As a result there is often apt to be enlargement of lymph glands about the lower jaws and cervical region.

Of particular importance to you is the fact that many peculiarities in the formation of the hard palate, and irregularities of the teeth are to be attributed to this interference with natural nasal respiration due to adenoids. I cannot speak in detail on this subject of deformities, for it is one with which I am not familiar, but I bring it to your attention because of the existing relationship to mine.

I have particularly dwelt on the above description because all of you come in contact with these types very frequently. They come to you begging you to do something to improve their appearance, especially of the dental deformities and irregularities.

At this point, gentlemen, I must conclude, not with a résumé of what I have read to you, but with a tribute to the great progress which is being made in the field of dentistry. I was astounded at my last visit to this clinic, by the type of work that you are doing here, the equipment for doing it, and the enthusiastic men behind you, teaching.

The contented mental state of a patient is a great factor in that patient's general well-being. And if you, with the possibilities that orthodontia has to offer, can promise relief from a depressive state of mind as well as the physical and organic discomfort caused by the various irregularities and deformities of the jaws and teeth, you are accomplishing a great good and deserve the moral support of the allied professions.

TRANSILLUMINATION OF THE TEETH AND GUMS

By Sterling V. Mead, D.D.S., Washington, D. C.

TRANSILLUMINATION of the teeth and gums should not be overlooked as a diagnostic aid. There is a tendency among many physicians and dentists to rely entirely too much upon the radiogram and to forget the importance of the clinical examination, transillumination, pulp testing, etc. Transillumination as a diagnostic aid is indispensable, as in many cases it is the only positive way to detect the presence of infection.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

The failure to detect shadows about the teeth and gums by transillumination does not eliminate the possibility of infection, however, as transillumination does not disclose bone pathology, except where it extends to the soft tissues. In other words, the pathology shown by transillumination is due to soft tissue infection.

Fig. 1 is a radiogram of maxillary central incisor. The tooth is pulpless and has a root canal filling. There is no radiographic evidence of osteitis or bone pathology. The line of the peridental membrane may be traced around the apex of the root without any widening of the space. Transillumination, however, showed a dark shadow and indicated tissue infection. The tooth was removed and definite infection found.

Fig. 2 is a photograph of the incisor shown in Fig. 1, showing the complete discoloration of the root.

Fig. 3 shows a radiogram of mandibular first molar. The tooth is pulpless and has root filling. There is no bone pathology shown. Transillumination, however, disclosed a dark shadow, indicating tissue infection. The tooth was removed and found to be infected.

Fig. 4 is a photograph of the case shown in Fig. 3, showing the discoloration of the roots.

Alabama Dental Association

The Fifty-ninth Annual Meeting of the Alabama Dental Association will be held in Birmingham, April 10, 11, and 12, 1928.

F. F. Perry, Secretary,
Montgomery, Ala.

Iowa State Dental Society

The Sixty-sixth Annual Meeting of the Iowa State Dental Society will be held in Des Moines, May 1, 2, and 3, 1928.

John Scholten, Secretary,
Cedar Rapids, Iowa

DEPARTMENT OF DENTAL AND ORAL RADIOGRAPHY

Edited By
Clarence O. Simpson, M.D., D.D.S., F.A.C.D.,
and Howard R. Raper, D.D.S., F.A.C.D.

A RADIOGRAPHIC STUDY OF FACIAL DEFORMITY*

By Martin Dewey, D.D.S., and Sidney E. Riesner, D.D.S., New York City

FOR a number of years orthodontists have been making photographs and plaster casts to record facial deformities. A photograph or plaster cast of the face gives only facial outline with no information regarding the position of the teeth to the facial contour. Therefore, facial casts with dental inserts have been suggested. The facial cast with dental insert if properly made, gives a great amount of information, but it possesses several serious drawbacks. The first difficulty with the facial cast with dental insert is the inconvenience to the patient; but a greater handicap is the amount of time needed to complete the facial cast. Furthermore, in order for the facial cast with dental insert to be of value as a scientific record, it must be made by some one possessing more than the average ability of the dental assistant or mechanic.

A photograph regardless of how accurate it is, gives no information regarding the underlying bony structures or the teeth as related to the face and cranium.

Knowing that Dr. Simpson had recommended a radiographic technic for securing the facial profile, Dr. Riesner began working upon radiographic profiles for the purpose of showing facial deformity. This method required first, the standardization of the position of the patient in which we utilized some of the suggestions made by Dr. Simon in his photostatic photograph. Secondly, it required a perfection of exposure and developing technic in order to show the profile in relation to anatomic structures. The results which he obtained very strikingly portrayed a great many anatomic characteristics and variations which we did not know existed prior to that time. In fact, at the present time, the radiographic photograph of the patient generally reveals something that is quite different from what one expects to find.

With this introduction we will now show you various types of profiles and will call your attention to certain anatomic characteristics and variations which are very noticeable. Furthermore, in viewing these x-ray profiles, I

*Read before the Twenty-sixth Annual Meeting of the American Society of Orthodontists, Chicago, May 2-5, 1927.

want you to remember that what you see is no more difficult to obtain than is the taking of an ordinary photograph. (At this time several lantern slides were shown which illustrated the advantages of the profile radiograph.) (Two reproduced here.)

After having seen these x-ray profiles you are undoubtedly interested in knowing the technic by which they were obtained.—MARTIN DEWEY.

RADIOGRAPHIC TECHNIC

BY DR. SIDNEY E. RIESNER

In pursuing further the technic of this method of diagnosis it probably will be a surprise to you to note its simplicity and ease of procedure. It does

not require any additional paraphernalia other than what a well regulated orthodontic office should have, namely, an x-ray machine and darkroom. Similarly, the technic may be divided into two parts: I. The exposure of the patient; II. The development of the film in the darkroom.

I. The exposure may be made with any type of x-ray machine on the market but the machine of preference is one that may be controlled to, or has a maximum of a three inch spark gap with ten milliamperes of current. This is specified for the particular reason that the results we desire depend upon recording the soft tissues of the face as well as the bony detail. If the current is stronger than this and the back-up is greater than three inches, with the

other factors the same, the x-ray will pass through our object with greater force, and only a very small amount of them will be absorbed by the soft tissues. They will penetrate our object to affect the silver salts of the x-ray film and blot out with darkened shadows everything but the more resistant structures such as the brain case and bones of the face. This is the effect usually desired when making a normal lateral exposure of the head, but not in our instance.

Peculiarly, what a roentgenologist would ordinarily call a "bad picture" is the very conclusion we desire. We mean by that one that depicts soft

tissues in conjunction with a bony area where the bone is the only desired image, i.e., a picture of the human hand that shows fleshy parts in clear outline together with the carpal, metacarpal and phalanges bones.

Therefore, the machine of our choice is one that will operate on 10 ma. of current with a three inch spark gap. The small dental type of x-ray machine with a Coolidge tube serves this purpose admirably.

The type of film is the Eastman Dupletized X-Ray Film superspeed 8 x 10 inches (20.3 x 25.4 cm.) placed in an Eastman X-Ray Exposure Holder (lead backed) 8 x 10. No intensifying screen is necessary as this tends to destroy

the fine detail of the facial contour that we desire. The extra rapid film accommodates the reduced time necessary for a good exposure. But an intensifying screen may be used if desired.

The patient is seated in a chair that will hold the head as immobile as possible, i.e., one with a head clamp. The holder containing the unexposed x-ray film is placed against the patient's face and cranium, and requested to hold it there with the palm of the hand against it. The fingers should be spread in fan fashion to cover a greater area in stabilizing the film against the face. The anterior border should be approximately one and one-half inches from the tip of the nose, and one and one-half inches from the chin to the lower border of the film. This is to insure the entire profile to be recorded on the film, and also serve as a standard position for subsequent exposures when repeated. Inasmuch as we desire the bones of the one side of the face to be perfectly superimposed on those of the other side, it is necessary for the patient's head to be parallel in a lateral plane. And if we want an exact reproduction in our subsequent exposures it should be fixed in a vertical plane. This may be guaranteed by having the patient bite on a small device, first suggested by Dr. Clarence Simpson, that contains a two-way level, one running at right angles to the other; this insures the head being fixed on two planes, that can be exactly reproduced at any time. In cases of extreme malocclusion where the plane of occlusion is such as to prevent us from using this double level, we can use a square containing two levels which are placed on each portion of the square. The eye, ear plane and the eye points as suggested by Dr. Simon can be used to place the head in a parallel or perpendicular position. One arm of the square is made to approximate the eye, ear plane and the head is tipped anteroposteriorly so as to make the eye, ear plane horizontal as indicated by the level. The other arm of the square carrying the level is made to approximate the eye points and the head tipped laterally to make the eye points parallel with the level. Using this right angle level at the anatomic points mentioned, the head can be placed in the exact position at any time. With a little experience positions can be very easily standardized.

The target skin distance must be sufficient to insure the entire film being included in the exposure. The base of the cone of the bundle of x-rays when it strikes the film must include therefore an area of 80 square inches on an 8 x 10 inch film. A target skin distance of 36 inches will cover this, if you have at least a two inch diaphragm from which the innervated cathode rays eminate.

The x-ray tube is then focused at right angles to a plane that bisects the head of the median line. The film held against the patient's face assumes the angle of the face as it slopes from the temporal region to the nose (a difference of about 35° from the right angle). Since the slope in normal cases is reasonably the same on both sides of the face, the mean distance of these two angles will be about the median line of the face.

The exposure is then made for seven seconds. An exposure for much more than this time will cause darkened areas and obliterate the profile on

the film, as was explained above. The time is diminished accordingly when an intensifying screen is used.

Two films should be inserted in the holder at the same time and a longer exposure made to get better bone detail. The latter may be developed longer than the one used to show the profile. This offers two pictures without any additional exposures of the patient.

II. The second part of the technic is the development of the film. The tank development method is preferable and is recommended because of the convenience, economy and the quality secured in negatives.

The developer is the Elon-Hydrochinon developer put up by the Eastman Kodak Company. It is composed of Elon, sodium sulphite, hydrochinon, carbonate soda, potassium bromide and water. The temperature should be 65° Fahrenheit.

The fixing formula is one for a plain acid-fixing bath of hypo and water to which is added the hardening solution of water and sodium bisulphite, acetic acid (28 per cent pure) and powdered potassium alum. The temperature should be the same as the developer.

The plate is removed from the holder in the darkroom and placed in the hanger. A convenient method of recording your factors or any other necessary data for your record at that time, is to write in lead pencil in one corner, the patient's name, the date and side exposed. When this is developed it cannot be erased and stands as a permanent record.

The film is inserted in the developing tank and allowed to remain about three minutes. This is approximately one-half the time allowed for an ordinary exposed x-ray taken for bony detail. If two films were exposed at the same time as was suggested one could be allowed to remain in longer till the bony details registered.

The film is washed for thirty seconds in running cold water and then placed in the fixing bath, where it remains until it clears.

Washing for twenty minutes in running cold water will thoroughly cleanse the film of all chemicals.

I might say that this same type of picture will also offer you an opportunity to include the very excellent suggestion which Dr. Lourie presented yesterday in noticing the position of the tongue. This same exposure will give you the position of the tongue without coating it with the bismuth paste, but to insure it, you may coat it with the bismuth paste and get any other features you may want. But the type of x-ray taken this way will give you all soft tissues.

DISCUSSION

Dr. F. M. Casto, Cleveland, Ohio.—The very excellent presentation of Drs. Dewey and Riesner has been very interesting. Their work has opened up a new and I believe, an important field in the use of the x-ray. A method, whereby the relation of the jaws and teeth to the facial outline can be recorded, and the anatomic variations noted may prove of inestimable value in the treatment of cases, and may also be highly valuable in research investigations. The apparent ease with which these exposures are made and the pictures pro-

duced, adds greatly to its usefulness. This may also be accomplished with a minimum of inconveniences to both the patient and the operator.

The pictures which Drs. Dewey and Riesner are making are most excellent and are made to portray a field which has long been undiscovered. They offer a splendid opportunity for a real scientific interpretation. I am sorry to admit that I have never used the x-ray to register the facial outline, and am therefore, wholly unable to discuss the subject from a scientific standpoint. From the deductions made by Drs. Dewey and Riesner, I can readily appreciate its value and shall adopt it as a regular routine upon my return. The continuous development of new and diversified uses of the x-ray in orthodontics has been remarkable. Today it is an indispensable adjunct in the practice of orthodontia. I have used it consistently and generously as an office routine for many years and would feel almost helpless without it. In my opinion an orthodontist who does not avail himself of the use of the x-ray in his practice liberally and religiously is subject to rather severe censure and sharp criticism. There are unquestionably many orthodontic problems which cannot be solved otherwise.

It has been a distinct privilege to inspect and witness the work of Drs. Dewey and Riesner. To my mind they have developed a very valuable procedure, and are to be commended upon the efficiency of it and upon its introduction into the practice of orthodontics.

Dr. Burt Abell, Toledo, Ohio.—It seems to me some of us should be led to understand how those two pictures are gotten. It has just been explained in private. I wanted to know if they have two films. They didn't say that.

Dr. Eby.—Dr. Riesner explained that the two films were in one holder. We will let him explain that in closing the discussion of the paper.

Dr. Riesner.—In reference to Dr. Abell's question, I might mention two films are inserted in the holder before the exposure is made. That will offer you two opportunities to develop the picture, one light enough so as not to destroy the soft tissue detail, and the second that will develop longer, brought up to its natural exposure—which by the way will give you a normal exposure of the teeth in the lateral exposure up to five minutes in the darkroom—to give you the regular bone detail.

Dr. Lloyd S. Lourie.—I am so delighted with this work that has been shown, particularly the negatives as shown in the radiographic exhibit, that I don't want any of you to miss the opportunity of seeing them. It is quite true, as is usually the case, that the slides do not show the detail that is shown in the negatives. I probably appreciate these results more than some of you, because in taking the radiographs of the tongue positions which I showed, some combinations of profiles and hard tissues were developed but they were not combined in the right proportion.

So I was delighted to see the radiographic exhibit of this work, and I think you will all miss something fine if you don't see the negatives.

I believe this opens up a very valuable field for studying the relation of the soft tissues to the teeth and bony base.

Dr. Albert H. Ketcham.—I have been greatly interested in this presentation. Years ago, in experimenting to see whether I could obtain good x-ray pictures of the temporomandibular articulation, in one underexposed film of a Class II case, I secured an excellent picture of the soft tissues as well as the hard, and through local reduction secured a very good negative. That aroused my interest, but I had not the time to follow it up. Now, Dr. Reisner has developed a technic which is splendid.

Dr. Dewey showed one case with lack of normal thickness of soft tissue over the mandibular mental eminence. I have had perhaps one-half dozen patients in which such a condition existed. After placing the teeth in occlusion we did not have much of a chin.

These profile x-rays will help us in studying the relation of the lips and the nose to the bony structures, and I think that those who are using Simon's technic will find a method like this of value in studying the relation of the soft to the hard tissues.

I am so greatly interested in this, Mr. President, that with your permission I would like to ask Dr. Reisner to join me in my x-ray clinic this afternoon. I think there will be ample time for both, and he can demonstrate his technic in securing these pictures.

Dr. Riesner.—I want to thank Dr. Lourie, Dr. Ketcham and Dr. Casto for their very kind reception, and I want to make a public acknowledgement to almost all the leaders of the Society that I have had the pleasure of meeting and explaining about the x-ray at the exhibit, for their very wonderful encouragement which they have given me. At this time I also want to acknowledge my public thanks to Dr. Dewey for his very liberal attitude in developing this and for offering all the materials that were necessary for the development of it. He gave me of his time and advice most liberally and also the patients to try it on I should like to make this public acknowledgement of my thanks and appreciation.

ABSTRACT OF CURRENT LITERATURE

Covering Such Subjects as

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA — DENTAL RADIOGRAPHY

It is the purpose of this JOURNAL to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Foods and Diet

Diet and Accessory Food Factors in Relation to Prevention of Diseases of the Teeth. J. Sim Wallace. Lancet, London, July 30, 1927, ccxiii, 218.

Wallace states that in his early investigations it became evident that there were several accessory food factors of great importance from the point of view of the prevention of caries, irregularities of the teeth, tartar and pyorrhea. The physical consistency of the food, when of such a nature that it required crushing and disintegration between the teeth, was often a factor helping in no small degree the cleansing of such parts of the enamel as were subjected to friction. Nevertheless, such foods as biscuits, coffee, and chocolate did not by any means leave the teeth clean. In a general way it was found that the more detergent foods were of a fibrillar nature, and in the case of vegetables this fibrillar substance was usually the carbohydrate known as cellulose. The accessory food factors were not only instrumental in maintaining oral hygiene, but they ministered also to alimentary hygiene in a similar way. Thus Dr. Percy R. Howe has shown that animals with intestinal derangement are quickly got into a healthy state by adding cellulose in the form of filter paper to their diet, and Dr. Wm. Cramer and Dr. A. N. Kingsbury have pointed out that in animals deprived of vitamine A the mucous glands atrophy and the alimentary canal becomes unhealthy.

Many physiologists and biochemists have concentrated their attention exclusively on these accessory food factors now known as vitamines. Nevertheless, at least with regard to oral hygiene and the development of the jaw, the other accessory food factors are in practice very much more important, because it but rarely happens that food as consumed is so thoroughly deprived of vitamines as to cause any trouble at all, or at least any specific disease.

Sim Wallace further states that a review of the facts brought forward in recent years indicates that except in so far as vitamines may stimulate the glands of oral hygiene, they appear to be of no appreciable value in the prevention of dental caries or irregularities of the teeth. He feels, however, that vitamines probably stimulate the glands of oral hygiene, and it is just possible that indirectly the absence of vitamines may occasionally predispose to disease resulting in hypoplasia of the teeth.

The limitation of the conception of accessory food factors to vitamines is very regrettable, since the other accessory food factors are of much greater practical value, especially with regard to the prevention of the diseases of the teeth. Moreover, when the other accessory food factors which are destroyed by cookery and the ultra refinement of food are sufficiently retained in the diet, it may be seen that the accessory food factors known as vitamines are amply provided for.

In regard to caries, Sim Wallace adds that it should always be observed that it originates entirely from conditions external to the teeth. The microscopic structure below the surface of the enamel has nothing whatever to do with its cause, only the external form and relations of the tooth can affect this. And if any hope for further profitable research with regard to vitamines and dental caries is to be made, this must be recognized. There are three ways in which vitamines might help in the prevention of caries:

(1) They might, and probably do, stimulate the proper functioning of the glands of oral hygiene.

(2) They might inhibit the proliferation and activities of the acid-forming bacteria associated with the disease.

(3) We know that nitrate of silver may stain and permeate the enamel, more especially where it is defective, and that this has an inhibitive effect on the progress of caries. It is just possible that "mortamines" might act in a similar way. We need not consider the hypothesis that vitamines, lympy or antibodies coming via the pulp are the factors required to harden or to secure immunity of the enamel to caries, since teeth with extirpated pulp may and generally do show an equal "vital" or deadly resistance to the disease.

Protein Metabolism. Graham Lusk. Canada Med. Assn. Jour., May, 1927, xvii, 5.

In discussing the subject of metabolism in general nutrition and during exercise, Prof. Lusk mentions the work of Fich and Wislicensus, who demonstrated that muscular exercise exerts no measurable effect upon the metabolism of proteins in the body. Up to the present time the author emphasizes the fact that not one iota of evidence has appeared to show any conversion of fat into sugar in the animal body.

Cereal Foods: Their Advantages and Dangers. William Weston. Southern Med. Jour., October, 1927, xx, 10.

Tradition and circumstances lead the author to believe that cereals were among the earliest foods used by the Chinese and Egyptians. Today there exists a wide range of preferences by the several peoples of the world for cereals of distinct flavor and of different food values.

Cereals grown under various conditions have been submitted to most careful chemical analysis and feeding tests to determine their nutritive qualities. For example, the U. S. Dept. of Agriculture found that for every fifty bushels of oats grown there is absorbed from the soil fifty pounds of nitrogen, eighteen pounds of phosphoric acid, forty-five pounds of potash, and twenty-

one pounds of lime. Moreover, it was found that the mineral content of cereals grown in Tennessee was considerably higher than in those grown in Minnesota.

It is estimated that for half of the peoples of the world, rice is the main article of food. It is marketed as polished and "cured" or "brown" rice. The "cured" or "brown" rice is rich in vitamines B and E, and contains a moderate amount of vitamines A and D. The ash is composed chiefly of phosphates, and is relatively high in these elements. It is the best source of iodine of all the cereals, and contains more than three times as much of the growth-promoting amino acid lysin as does any other cereal. Polished rice is deficient in both vitamines and mineral elements. From the standpoint of energy value, oats is probably superior to any of the other cereal grains.

Cooking and Food Value of Eggs. A. Scheumert and E. Wagner. Deutsch. med. Wchnschr., July 22, 1927, liii, 1238.

The authors fed young rats with raw, soft boiled and hard boiled eggs. The rats did not thrive on raw eggs, but developed well when the eggs were boiled.

Liver Feeding in Pernicious Anemia. Clinic of Drs. Elliott, Nadlet and Starr. Med. Clin. N. A., July, 1927, xi, 1.

After reviewing the favorable results in their clinic, Elliott and his coworkers feel that the application of liver feeding to cases of pernicious anemia suggested by recent experimental work has added to the therapeutic armamentarium of this disease an agent that gives results not approached by any other measures. The clinical fact seems established that liver added in sufficient quantity to the diet of typical pernicious anemia patients will produce a remission.

The most valuable recent studies on the effect of diet on blood regeneration have been made by Whipple, Hopper and Robschelt-Robbins. In carefully controlled experiments on dogs they showed that both hemoglobin regeneration and bile-pigment excretion are influenced by modification of diet.

Whipple and his coworkers found that bile-pigment excretion is increased on a carbohydrate and decreased on a protein diet, while hemoglobin regeneration is slow on a carbohydrate and rapid on a protein, especially on a liver, diet.

It has been suggested by Koessler that pernicious anemia is a vitamine deficiency disease. The liver has a vitamine content probably higher than that of any other organ.

Koessler, Maurer and Loughlin advocate the following vitamine theory of pernicious and other severe anemias: That the blood and gastrointestinal changes may be due to chronic vitamine A underfeeding, the nervous symptoms to vitamine B deficiency or absence, and the hemorrhagic tendencies to partial or complete lack of vitamine C. They recommend a diet containing *liver or other high nucleoprotein food (100 gm. daily),* fresh fruit and vegetables, a relatively high fat content in the form of butter, cream, milk and egg-yolk, and the addition of cod-liver oil (5 c.c. four times daily), yeast

tablets, and dilute hydrochloric acid (30 drops before, during, and after each meal).

The Banana as a Food for Infants and Children. L. von Meysenberg. New Orleans Med. and Surg. Jour., September, 1927, lxxx, 3.

The writer gives a preliminary report of one year's observation of banana as a food for infants and young children. Von Meysenberg fed banana in the diet of ninety infants ranging from four months to two years, and only two could not tolerate it because of its laxative effect. Bananas are an excellent source of vitamines A and C, a good source of B, deficient in D, and show the presence of C.

The fat and protein factors are negligible. The chief food constituents are the carbohydrates which amount to about 22 per cent. It is a good source of lime and its iron content is higher than in any other fruit, with the exception of strawberries.

Its caloric value of one calorie per gram of ripe banana pulp or 447 calories per pound is much higher than that of the common fruits.

The writer tried various methods of preparing the banana, and found the most satisfactory of these to be fruit pressed through the sieve, and for an infant four to five months of age 1 teaspoonful is given and cautiously increased to 6 to 8 teaspoonfuls. Children should be allowed to eat only a ripe banana, that is, one having the skin entirely yellow with brown and black spots and without green tips.

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EDITORIALS

Further Facts Regarding Malpractice Suits and Professional Insurance

IN THE November, 1927, issue we published an editorial entitled "Malpractice Suits and Professional Insurance." We called attention to the fact that many liability policies which were supposed to protect the dentist against malpractice suits, really contained jokers that protected the dentist against only a small number of possible malpractice suits.

Since the above-mentioned editorial appeared, we have received many letters from dentists in different parts of the country, containing sample policies carried by them individually, or copies of group policies carried by the Society to which they belong. We have received letters also from attorneys for different insurance companies. All the letters from attorneys stress the point that no insurance company can write a policy which can protect professional men from "breach of contract" suits. In replying to these statements we are reminded by what Elbert Hubbard once said, "It is very foolish

to say a certain thing cannot be done because we invariably go around the corner, and find some fellow doing it."

In reference to insurance companies offering protection against "breach of contract" suits, we know of one liability company that has written a new contract to meet the various criticisms that appeared in our editorial entitled "Malpractice Suits and Professional Insurance." This company has written a clause which specifically protects the insured against "breach of contract" suits. The policy also provides protection for the insured against any mistakes of treatment or errors of judgment that might be made by any one in the employ of the insured. It also provides protection against injuries sustained from the use of the x-ray. In fact, we can conceive of nothing at the present time that this policy does not cover in the way of professional liability.

It is needless to say that this particular company will eventually write most of the liability insurance for the various societies and individuals unless these other companies who claim such a thing cannot be done, meet the issue squarely and change their insurance policies accordingly.

Prior to the writing of our editorial, one company was defending all "breach of contract" suits that were filed against their policyholders. The company took this attitude because the majority of so-called "breach of contract" suits were not true "breach of contract" suits. Such suits were defended free of charge to the policyholder, and if judgment was rendered under "breach of contract," the policyholder paid the judgment. It must be remembered that in a true "breach of contract" the plaintiff cannot collect a judgment greater than the fee involved for the work under dispute. If the plaintiff alleges personal injury then it ceases to be a true "breach of contract" suit.

The company previously referred to as having written a new policy, has limited the amount of judgment to be collected under the term "breach of contract." They have set a limit which will more than cover the average suit involved as a true "breach of contract" suit.

In referring to some of the correspondence we have had on the above-mentioned editorial, one group of attorneys insisted that a "breach of contract" suit and a tort could not be filed as one suit. Again we must refer those men to the statement of Elbert Hubbard because such a thing actually was done.

We found some of these group policies protect the insured but do not offer protection to him for mistakes or errors made by any of his associates or assistants if they are paid a salary or commission. Such contracts also contain the statement that the insured is not protected if he is working on a salary or commission. Such a clause would hardly be noticed by the average policy holder but would be one that would lead to an enormous amount of embarrassment and expense.

For example, if a dentist was employed in a public school or health clinic, or employed by a hospital, he would not be protected against any suit brought by a patient whom he had treated in the clinic, because the insurance company would deny responsibility, stating the dentist was working on salary. They also make no mention of protecting the insured against x-ray burns or

accidents and such companies contend the x-ray is not an ordinary professional procedure.

Therefore, these companies write a rider to the policy for an increased premium, which protects the insured against claims for x-ray injuries. Unless it is specifically mentioned in the insurance policy, we would advise every man to insist on a rider attached to the policy stating that he is protected against suits arising from x-ray injuries.

As we have previously stated, the average liability policy does not protect the professional man against any sort of suits except those arising from personal injury or death. Even personal injury and death suits are limited to those that arise when the individual is working on a private patient for a professional fee, and do not protect him if he is working in a clinic or engaged in a public health service, or if work has been done by an associate if a salary is paid to the operator.

In fact, the majority of those policies are wonderful for the amount of things against which they do not protect you.

ORTHODONTIC NEWS AND NOTES

The American Society of Orthodontists

Preliminary Report of Program

The next annual meeting of the American Society of Orthodontists will be held in Buffalo, New York, April 30, May 1, 2, and 3.

The various officers of the Society are working in unison to bring about an attractive and interesting program for this meeting. The program is practically completed at this time; however, it is not in shape for publication on account of various minor changes which are being made. There will be a round table similar to the one held in Chicago last year for the discussion of various informal topics pertaining to the practice of orthodontia. There will also be competitive clinics in accord with the precedent as established a year ago. There will be an essay pertaining to the field of the endowed dental infirmary in orthodontic education. There will be an essay on orthodontic bibliography. There will be a most complete and detailed essay pertaining to the modern and very popular lingual appliance. There will be a report of scientific research as being conducted by some of the members on the subject on bone growth and the physiologic progress of the bone centers of the hands of normal children.

Not the least, there will be recreation. A trip to Niagara Falls, a motor trip down the river, luncheon at the Country Club, golf and sight-seeing, a banquet, and entertainment for the ladies.

The Eastern Association of Graduates of the Angle School of Orthodontia

The annual meeting will be held at the Hotel Vanderbilt, Park Avenue and 34th Street, New York City, on Monday and Tuesday, May 14 and 15, 1928.

E. Santley Butler, Secretary,
576 Fifth Avenue,
New York City

Southwestern Society of Orthodontists

The Eighth Annual Meeting of the Southwestern Society of Orthodontists will be held in Kansas City, Mo., April 27 and 28, 1928. At close of the meeting members will go in special cars to the American Society of Orthodontists' Meeting in Buffalo. A special invitation is extended to Rocky Mountain and Pacific Coast Societies to attend our meeting and continue with our party to Buffalo.

Write Dr. Hugh G. Tanzy, Commerce Building, Kansas City, for proper routing of your ticket from Kansas City to Buffalo.

P. G. Spencer, Secretary,
1407 Amicable Bldg.,
Waco, Texas

American Dental Association

Minnesota—Vacation Land

Now is the time to think about your summer's vacation. Minneapolis and its surrounding country-side is open to you for the greatest vacation you have ever enjoyed. This summer you can plan to take in the greatest meeting the American Dental Association has ever held, and at the same time take advantage of the many recreational facilities that the great State of Minnesota affords its visitors.

Every taste can be satisfied in Minnesota. You will find luxury and refinement in modern resorts, a carefree western spirit of welcome in tourist camps. You may enjoy the solitude and beauty of the North Woods in some hidden cabin or on a canoe trip; you may rest in a quiet family hotel, or you may frolic at some gay rendezvous.

From Minneapolis, our next Convention City, seven thousand miles of Minnesota's trunk lines lead to superb fishing spots, camps, resorts, canoe trails through primeval forests, prosperous farm lands—or what do you want?

Plan your vacation now. Write to the American Dental Association Headquarters, 301 Donaldson Building, Minneapolis, Minnesota, for any information you may desire. It is yours for the asking. We have pledged ourselves to entertain you. Drop us a line. Above all, COME AND BE CONVINCED!

Southern Society of Orthodontists

The annual meeting of the Southern Society of Orthodontists will be held at The Southern Hotel, Baltimore, Maryland, on April 27 and 28, 1928. A cordial invitation is extended to all ethical members of the dental and allied professions.

Oren A. Oliver, Sec'y-Treas.,
1101 Medical Arts Bldg.,
Nashville, Tenn.

The Dental Society of the State of New York

Preliminary Program

The 60th Annual Meeting of the Dental Society of the State of New York will be held at the Hotel Syracuse, Syracuse, N. Y., on May 16, 17, and 18, 1928.

Literary exercises, clinics, exhibits, etc., will be held at the Hotel Syracuse. Dr. Daniel Jutton, 405 E. Fayette Street, Syracuse, N. Y., is chairman of the Exhibits Committee. Dr. I. J. Silverman, 541 E. Genesee Street, Syracuse, N. Y., is chairman of the Clinic Committee.

The Executive Council will convene, for the transaction of the business of the Society, on Tuesday, May 15th, at 3:00 P.M.

Essayists.—Dr. Edward C. Kirk, Philadelphia, Pa.; Dr. Chalmers J. Lyons, Ann Arbor, Mich.; Dr. William E. Harper, Chicago, Ill.; Dr. R. H. Volland, Iowa City, Iowa; Dr. M. M. House, Whittier, Calif.; Dr. Edward Kennedy, New York City.

During the time of the meeting, sessions of the New York State Dental Hygienists Association and the Dental Assistants Association will be held.

Headquarters will be at the Hotel Syracuse and reservations should be made direct with the hotel management. For further information apply to the Secretary.

Dr. A. P. Burkhart, Secretary,
57 E. Genesee Street,
Auburn, N. Y.